Distribution of Haddock (*Melanogrammus aeglefinus*) Eggs and Larvae on the Scotian Shelf, Eastern Gulf of Maine, Bay of Fundy and Eastern Georges Bank

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ABSTRACT

Hanke, A. R., F. H. Page, and J. Neilson. 2000. Distribution of haddock (*Melanogrammus aeglefinus*) eggs and larvae on the Scotian Shelf, Eastern Gulf of Maine, Bay of Fundy and Eastern Georges Bank. Can. Tech. Rep. Fish. Aquat. Sci. 2329: iii + 140 p.

The temporal and spatial distribution of sampling and the sampling protocols used during the Canadian Department of Fisheries and Oceans Larval Herring (LHP), Scotian Shelf Ichthyoplankton (SSIP) and Fisheries Ecology Programs (FEP) are summarized. In addition, the spatial distributions of Stage I, II and early Stage III cod/haddock/witch eggs and late Stage III haddock eggs, Stage IV haddock eggs and 1- to 7-mm and >7-mm haddock larvae are presented for each survey and are aggregated over all programs and time to form general and bimonthly composites. To avoid standardizing the sampling effort for differences among sampling protocols and gear types used in the survey programs, the distributions of haddock early life history stages were determined using a presence/absence criterion rather than the actual abundance. The samples selected from the LHP database were those collected using a 61cm Bongo outfitted with either 505- or 333-µm mesh and towed in a saw-tooth fashion. The FEP is represented by samples taken with a 333-µm mesh and a double oblique tow only, whereas the SSIP is also represented by samples collected with a 471-µm mesh and an old stepped oblique tow.

RÉSUMÉ

Hanke, A. R., F. H. Page, and J. Neilson. 2000. Distribution of haddock (*Melanogrammus aeglefinus*) eggs and larvae on the Scotian Shelf, Eastern Gulf of Maine, Bay of Fundy and Eastern Georges Bank. Can. Tech. Rep. Fish. Aquat. Sci. 2329: iii + 140 p.

Le présent document résume la distribution temporelle et spatiale des échantillons et des protocoles d'échantillonnage utilisés dans le cadre de trois programmes du ministères canadien des Pêches et des Océans, soit le Programme d'étude des larves de hareng (PELH), le Programme d'étude de l'ichtyoplancton de la plate-forme néo-écossaise (PEIPFNE) et le Programme de l'écologie des pêches (PEP). En outre, on présente des données sur la distribution spatiale des œufs de morue, d'aiglefin et de plie grise aux stades I et II et au début du stade III, ainsi que sur la distribution spatiale des œufs d'aiglefin à la fin du stade III, des œufs d'aiglefin au stade IV et des larves d'aiglefin mesurant de 1 à 7 mm et de >7 mm. Ces données sont présentées pour chaque relevé puis sont regroupées pour l'ensemble des programmes et réparties sur toute la période pour former des moyennes composées bimestrielles. Afin d'éviter de normaliser l'effort d'échantillonnage pour ce qui est des différences entre les protocoles d'échantillonnage et les types d'engins utilisés dans les programmes de relevé, les distributions de l'aiglefin aux stades précoces ont été déterminées au moyen de critères de détection d'indicateurs de présence ou d'absence plutôt qu'en fonction des effectifs réels. Les échantillons prélevés dans le cadre du Programme d'étude des larves de hareng ont été prélevés au moyen d'un filet Bongo de 61 cm, ayant un maillage de 505 ou de 333 µm, et moyennant des traits en forme de dents de scie. Le PEP est représenté par des échantillons prélevés au moyen d'un filet au maillage de 333 µm et de traits doubles obliques uniquement, alors que le PEIPFNE est également représenté par des échantillons prélevés au moyen d'un filet de maillage de 471 µm et d'un ancien modèle de traits obliques par paliers.

INTRODUCTION

The purpose of this report is to make the temporal and spatial distribution of haddock eggs and larvae, contained within three Canadian Ichthyoplankton Survey Programs, readily available for quick visual perusal. Hence, the report briefly describes each survey program and the location of the data. It combines the information from all surveys into bimonthly and single composites for each early life stage to highlight the major temporal and spatial patterns in distribution and presents stage specific distribution plots for each individual survey within each program for more detailed reference. Investigators wishing to pursue more detailed analyses should extract the data from relevant databases.

Ichthyoplankton data have been used for a variety of fisheries-related studies. For example, Gagné and O'Boyle (1984) and O'Boyle et al. (1984) used Scotian Shelf Ichthyoplankton Program (SSIP) data to test hypotheses of larval retention, noting that for many species of fish occurring on the Scotian Shelf, both the eggs and larvae appear to be retained over the banks for considerable periods. Neilson and Hurley (1986), Neilson et al. (1986), Neilson et al. (1988) and Hunt and Neilson (1993) employed the data to elucidate stock structure of flatfish and gadids in Maritime waters. Hurley and Campana (1989) examined the Fisheries Ecology Program (FEP) data to describe the distribution of early life history stages of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). However, no single work has combined all available ichthyoplankton data for haddock (*Melanogrammus aeglefinus*) in the Maritimes Region in a comprehensive manner.

MATERIALS AND METHODS

DATA SOURCES

The data pertaining to the distribution of the early life stages of haddock on the Scotian Shelf, eastern Gulf of Maine, eastern Georges Bank and the Bay of Fundy have been compiled from three Canadian Department of Fisheries and Oceans ichthyoplankton survey programs conducted during the 1970s, 1980s and 1990s. These programs were the Larval Herring Program (LHP), the Scotian Shelf Ichthyoplankton Program (SSIP) and the Fisheries Ecology Program (FEP). An overview of the temporal and spatial coverage of each of these survey programs is given in Table 1 (note that the survey-specific distribution plots described in the following results sections provide a good view of the relative spatial coverage of each survey). A more detailed description of each program is given below.

Larval Herring Program

The Larval Herring Program (LHP) is an ichthyoplankton survey that has been conducted using standardized procedures since 1972 (Iles et al., 1985). This report includes only surveys conducted until 1997. Survey coverage focused on the Bay of Fundy, the area off southwest Nova Scotia, and Georges Bank (Fig. 1). In the Bay of Fundy (BoF), spring and fall surveys were conducted each year from 1975 to 1984 (Fig. 2). Starting in 1985, the program was reduced to only one fall survey per year (Table 2). The Georges Bank (GB) surveys began in 1987 and ended in 1997 and consisted of a single fall survey each year (Fig. 3, Table 3). Data from the surveys are stored in an ORACLE database residing at the St. Andrews Biological Station, New Brunswick, Canada.

The original purpose of the LHP was to increase knowledge of the ecology of herring larvae, and was designed to coincide with the larval abundance peak resulting from an assumed spawning peak of September 1 (Iles et al., 1985). Since the focus of the LHP was on herring, not all samples were sorted for species other than herring. Hence, there are some BoF and GB surveys not involved in the distribution plots. All known exceptions are noted in Table 4.

The sampling scheme for the Bay of Fundy surveys initially followed a standard grid of 116 stations (numbered 001-116). Stations on the grid were meant to be 10 nautical miles apart, but for practical reasons some are only 5 mi apart. Sampling was carried out within ±0.5 mi from the master station coordinates.

Over the years, the grid was expanded to 163 stations, with a number of additional random stations added periodically. In 1988, 1989, and 1990, 80 random stations were added to compare with results obtained from regular grid stations; however, these extra stations do not appear in this report. The 80 random stations were added in an area of traditionally high herring larval density off southwest Nova Scotia (Stephenson et al., 1990).

The Georges Bank surveys within the Larval Herring Program followed a different sampling scheme. In this program, sample stations were allocated within a grid of 20 x 20 mi blocks. Beginning in 1988 this allocation was done on a random basis.

Scotian Shelf Ichthyoplankton Program

The Scotian Shelf Ichthyoplankton Program was conducted during the years 1976 - 1982. This program was designed "to provide basic information on the spatial and temporal distribution of eggs and larvae on the Scotian Shelf as an aid to the better management of the fishery." (O'Boyle et al. 1984). The data are maintained within an ORACLE database at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia. Detailed descriptions of the program and the data set are given in Anon. (1989). A brief summary of the program is given below with an emphasis on the surveys and sampling procedures used to collect the data analysed in this report.

The SSIP data set includes 39 surveys. Each survey covered the Scotian Shelf to some degree (Fig. 1). Five of the surveys were not included in the present analyses (Table 5) since the data associated with these were not appropriate for the present purpose. Three of these surveys were primarily patch studies focused on the limited geographic region of Emerald and Western Banks and two surveys targeted silver hake. The data for the remaining thirty-four surveys (Table 6) were available and were included in the present analyses. The temporal coverage by these surveys is presented in Fig. 4.

Surveys conducted prior to 1977 consisted of a grid of 150 consecutive stations covering the Scotian Shelf from the Laurentian to the Northeast Channel. Beginning in 1977, a conventional sampling grid approach (the "Standard Transect Grid") covering the Scotian Shelf, parts of the continental slope and Georges Bank, and the northeastern half of the Gulf of Maine was adopted. The objective was to mirror the California Cooperative Oceanic Fisheries Investigations (CalCOFI) survey design, and in particular to achieve standardization with the Marine Resources, Monitoring, Assessment and Prediction (MARMAP) survey on the US East Coast. The grid consisted of 40 transect lines running perpendicular to the Nova Scotian coast, 15 miles apart. Stations along each transect were located at depth discontinuities. There were between 3 and 11 stations along each transect. In 1978, standardized procedures were adopted and a total of 245 stations were sampled. From 1979-82, the sampling protocol was reduced to 150 primary stations in order to save time and help ensure the entire survey domain was sampled by each survey.

Fisheries Ecology Program

The Fisheries Ecology Program was initiated by the Marine Fish Division of the Canadian Department of Fisheries and Oceans to learn more about the ecology of the commercially important gadoid species, particularly haddock, on the southwestern Scotian Shelf (Smith et al. 1989). The surveys covered the Scotian Shelf off southwest Nova Scotia (Fig. 1). Yearly, five surveys were conducted from 1983-1985 (Table 7), for a total of 15. In each year, the surveys were conducted monthly from February through June (Fig. 5).

The initial 1983 sampling scheme for the survey consisted of a grid composed of 11 transects and 85 stations in total. The stations were approximately 28 km apart for most of the survey domain and somewhat closer over the western portion of Brown's Bank. In 1984 and 1985, two additional transects were added that traversed Brown's Bank. There were 6 stations in each new transect for a total of 97 stations (Hurley and Campana, 1989). The data are stored in an ORACLE database maintained at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia.

Sample storage identification and protocols

Many thousands of plankton samples were collected during the LHP, SSIP and FEP (Table 8, 9, 10, 11). The range of sampling approaches included vertical hauls with a 1-m diameter net, oblique and saw tooth tows with a 61-cm Bongo or Isaacs-Kidd net to within 5 m off the bottom or 200 m maximum depth and surface tows with a 61-cm Bongo or Neuston net. Of these approaches, only the Bongo tows were processed for ichthyoplankton of which only the information from the saw tooth and oblique Bongo tows was used in the present analyses. Depth was determined by a conductivity-temperature-depth (CTD) recorder attached above the Bongo frame. A flow meter attached inside the mouth of the net measured the volume of water filtered through the nets during each tow. The nets were towed at a target speed of 2.5 knots (1.3 $m \cdot s^{-1}$), lowered and retrieved at wire out and in rates of 20 and 50 $m \cdot min^{-1}$, respectively. A range of mesh sizes was also used with each gear type (Table 8, 9, 10, 11). More than 90% of the port samples and less than 50% of the starboard samples were processed for fish eggs and larvae. During the FEP in 1984 and 1985, replicate bongo samples were taken immediately after completion of the first tow by returning to the initial starting location and redeploying the bongo gear. These replicate tows accounted for 67% of the stations sampled during the FEP. The starboard samples were generally sorted to compare the catches from port and starboard nets and when the port sample was unavailable. Rather than use the information from both replicate tows and both sides of the bongo, when these were available, only the information from the port side of one sample was used in the present analyses. However, in cases where a port sample was not available, a starboard sample, if available, was used instead.

The fish eggs and larvae from each sample were classified into four developmental stages (Table 12) and identified to species when possible. The larvae were measured to the nearest millimeter. Samples containing more than 200 eggs were sub-sampled using the beaker split method of Van Guelpen et al. (1982). Since the Stage I, Stage II and early Stage III eggs of cod, haddock and witch cannot be distinguished from each other, they were identified as cod/haddock/witch (CHW) eggs or less frequently as cod/haddock (CH) eggs.

DATA ANALYSES

Type of data extracted

From the above surveys, certain data records were not selected because they were associated with undesirable fish and egg identification protocols (fishproc codes 2, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16; Table 13). This restriction eliminated entire surveys from the LHP program as indicated in previous sections (Tables 4 and 5). Acceptable fishproc codes included 1, 3, 4, 6 and 7. Surveys with all fishproc codes equal to 6 (identified and counted selected fish and no fish eggs) and no haddock caught were not plotted. When fishproc was 3 (identified and counted all fish and no fish eggs) only larval plots were generated (e.g. surveys P190 and P217). When fishproc was 4 (identified and counted selected fish and all fish eggs) or 7 (identified and counted no fish and all fish eggs) only egg stage plots were created (e.g. surveys P160, P175, P190 and P207). Fishproc 1 yielded both larval and egg stage plots.

Of the remaining records, those samples originating from a 61-cm bongo (geartype=94), towed according to the saw tooth (gearproc=7), old stepped oblique (gearproc=4) or MARMAP double oblique (gearproc=3) procedures, were retained. This selection resulted in all the acceptable LHP surveys being saw tooth bongos and all SSIP/FEP surveys being MARMAP double oblique bongos except surveys P170, P182, CL01, FT01, CC01 and CC02 which were old stepped oblique bongo tows.

Net mesh sizes for the bongo tows included 333, 471 and 505 µm, where preference was given to the smallest mesh available and the port side sample. If these criteria resulted in more than one sample/set, the record with the smallest sample number was selected. The 471-µm mesh was used exclusively for bongo tows in surveys P182, CL01, CC01 and CC02.

Records were also rejected according to their method of sample preservation. When sampcura, the database field for sample processing, was null, 0 or 99, the record was discarded because the sample was considered damaged, lost or unrepresentative.

Finally, each record was associated with a station identifier, set number, date and geographic position. The position of a station was equated with a single latitude and longitude, since set locations for a station tended to vary slightly from year to year. In the case of Bay of Fundy surveys, random stations were omitted (those stations beginning with R or A) because they were added in only three years in areas of traditionally high herring density off the coast of southwest Nova Scotia. Their purpose was for a comparison with results from regular grid stations. These extra stations did not yield any haddock larvae or eggs.

Presence/absence plots

A presence/absence approach was considered the best way for visualizing the general patterns in haddock distributions. Distributions represented by abundance at location are unduly influenced by those locations where large numbers are caught. Even log-scale transformations cannot reduce the visual impact that these high catches have on the perception of haddock distribution. The equal weighting that a binary approach attributes to each location where haddock were found may be a more appropriate way of dealing with inadequacies in the sampling grid.

Temporally, a binary representation is also more robust. Complex physical processes control the distribution of ichthyoplankton on a continuing basis. Yet, abundance-based distributions present the data as though it came from a static environment without a significant temporal component incorporated in the sampling. The binary approach reduces the impact of variability of survey timing on the perceived distribution of haddock eggs and larvae since only areal issues are important.

For those situations where samples have various collection histories, abundance based distribution plots should not be produced without first transforming the samples to a common collection protocol (sampling effort). Standardization may not always be possible since the conversion relationships are not always known. A presence/absence approach minimizes the standardization issue because knowledge of relative abundance is not required.

Distribution plots of the presence and absence of each early life stage were plotted for each individual survey. To help extract robust features in the temporal and spatial distribution of the early life stages the data were also combined into a single distribution plot and bimonthly plots for each stage. All plots depict the location of the target species given the data selection criteria described above. For the composite plots, the presence of the target species was shown when more than one egg or larva was counted in a sample. This elevated detection threshold was established to decrease the likelihood of plotting misclassified eggs or larvae or outliers in both space and time. The overall outcome was a more compact plot of species distribution that showed more coherence from month to month and among stages. A shortcoming of the plots is their ability to mislead the eye when comparing regions with unequal sample densities. This problem is particularly evident when comparing the eastern Scotian Shelf with either Georges Bank or the Bay of Fundy at certain times of the year.

The early developmental stages (Stages I, II and early Stage III) of cod, haddock and witch cannot be classified to the species level. Hence, the presence data for the early stages of haddock was obtained by apportioning the data identified as the species mix of cod/haddock/witch (CHW) and cod/haddock (CH) for each sample. The proportion of Stage I, II and early Stage III haddock in the mix of CHW and CH was assumed to be identical to the proportion of late Stage III haddock caught relative to the total number of late Stage III cod, haddock and witch caught in the sample. The Stage I and II apportioned data are presented in the general and bimonthly plots. However, for the Stage I, II and early Stage III survey plots, all locations where CHW and CH were found were superimposed on the locations where late Stage III haddock were found. This allows the reader to judge which CHW and CH locations contained haddock based on their proximity to known haddock locations.

RESULTS

Before the composite plots are described (Fig. 6, 7.1-7.6), a cautionary note regarding the sampling intensity in each season is warranted. Upon examination of the survey dates for each program, one will note that the sampling intensity is not even throughout the year. The FEP only has data from February 1 to June 21 in 3 yr, 1983-85. The GB arm of the LHP sampled in October from 1987 to 1991 and in November from 1992 to 1997. The BoF arm of the LHP, in addition to sampling in October/November from 1975 to 1997, sampled in March from 1975 to 1984 and in August from 1977 to 1980. The SSIP sampled in virtually every week of the year, but the majority of effort was centered on the period between August 1 and September 31 from 1975 to 1982 and in the remainder of the year some months were only sampled in 1 or 2 yr. Thus, when the data from all programs is aggregated into bimonthly plots, the FEP and BoF are the main contributors to the March-April plot while the fall BoF surveys and GB surveys are the main contributors to the November-December plot. The July-August plot gets some data from the BoF surveys but more from the SSIP. The remaining plots have a large SSIP/FEP component. Also, some of these plots are supported by an unbroken time series while others represent a short segment of time. In fact, the points on the plot will also have a hidden degree of sampling where the same location is visited in multiple years but is represented by a single point. Consequently, comparisons between plots for different months should be done with the understanding that some plots have had a higher level of sampling which may give the impression of more eggs or larvae. Comparisons between stages for the same bimonthly period are more appropriate.

GENERAL COMPOSITE (Fig. 6)

The general composite plots identify the geographical extent of the early life stages of haddock aggregated over all programs, seasons and years. The apportioning method applied to Stage I and II CHW and CH eggs does not produce occurrences for these stages outside the domain of the Stage III haddock eggs. This is because Stage III haddock must be present in order for Stage I or II CHW and CH to be classified as haddock.

The major spawning areas, based on Stage I and II apportioned CHW and CH egg and Stage III haddock egg occurrence, appeared to be centered over Emerald and Western Banks on the western Scotian Shelf, on the eastern tip of Georges Bank, on Browns/Baccaro Bank, and the waters off southwest Nova Scotia. Stage IV haddock eggs occupied a similar range as Stage III eggs. Both classes of larvae maintained the spatial extent of the Stage IV haddock eggs but in the case of the larvae >7mm the density of occurrences was less.

Haddock eggs and larvae were rarely found within the Bay of Fundy or on the eastern Scotian Shelf.

BIMONTHLY COMPOSITES (Fig. 7.1-7.6)

The seasonal pattern in the distribution of Stage I and II apportioned CHW and CH eggs and Stage III and IV haddock eggs are similar in their times and general areas of occurrence and spatial extent.

Haddock spawning throughout the surveyed area was most pronounced from March through June. Virtually no Stage I and II apportioned CHW and CH eggs, Stage III and IV haddock eggs, and 1- to 7-mm-long haddock larvae occurred in the July to December period. This absence also applies to larvae >7 mm except for a small number found in July-August off southwest Nova Scotia.

The first sign of haddock spawning, as seen in all egg stage plots, was in January-February on Georges Bank. The areal distribution for eggs was small and larval haddock were absent. The egg stage plots also show that in March-April the Georges Bank group expanded its range and Browns Bank spawning begins. Spawning also occurred near Emerald and Western Bank and eggs can be found scattered between Browns and Emerald Bank. This pattern exists in the plot of 1-7 mm long haddock larvae as well. A single occurrence of larvae >7 mm was observed on Georges Bank and three on Emerald Bank in this period.

In May-June, all egg stages were again detected on Georges and Browns Bank and in the greater southwest Nova Scotia area. On the central Scotian Shelf, the frequency of haddock egg occurrence was much lower than observed in the prior bimonthly period, whereas the 1- to 7-mm larval occurrence remained high. Also in this time period, haddock larvae > 7mm exhibited their greatest occurrence and spatial coverage, following the pattern of occurrence established by earlier life stages.

The evidence from the composites suggests that at least three spawning populations of haddock exist. These are Georges Bank, Browns Bank/southwest Nova Scotia and the central Scotian Shelf. These groups appear to have staggered spawning times. Spawning begins first on Georges Bank in January-February. Spawning on Browns Bank/southwest Nova Scotia and the central Scotian Shelf begins in March-April. Spawning in all areas ends in May-June. Peak egg occurrence occurred on Georges Bank and the central Scotian Shelf in March-April and in May-June in southwest Nova Scotia and Browns Bank.

SURVEY-SPECIFIC DISTRIBUTIONS

The large number of figures associated with the description of the survey-specific distributions has been organized using a hierarchical system. The first level identifies the sequential figure number. The second level identifies the program and the third refers to the life stage.

LHP-Bay of Fundy (Fig. 8.1.1-8.1.7)

Stage I, II and III CHW eggs were observed at numerous locations in a variety of months and years but at only a few stations did they coincide with the presence of a late Stage III haddock egg. The March 1982-1983 surveys each had one station off southwest Nova Scotia with late Stage III haddock eggs. The only fall sampling that detected late Stage III haddock eggs was conducted in October 1986. Three stations with such eggs occurred off the coast of Maine and one along the Digby Neck. The only Stage IV haddock occurrence was also along Digby Neck by the same survey.

Larval haddock were detected during a March and an August sampling off the southwest coast of Nova Scotia. Both larval groups (especially larvae > 7mm) occurred at many locations within this area in the August 1979 sample. Only one station with haddock larvae > 7mm long occurred in the March 1981 sample.

LHP-Georges Bank (Fig. 8.2.1-8.2.7)

Although Stage I, II and III CHW and CH eggs were observed in every year from 1987 to 1995 on Georges and Browns Bank (when sampled), no haddock eggs or larvae were detected. However, sampling took place in late October and November only, and was generally limited to the northern part of Georges Bank.

FEP (Fig. 8.3.1-8.3.7)

The FEP data set provides a good time series for haddock distribution in a select number of years, months and geographic locations. The location consistently sampled was Browns Bank while northeast Georges Bank was included occasionally. The surveys were conducted in each month from February to June.

The trend for the late Stage III haddock eggs in all 3 yr, described in more detail below, is to appear first on Georges Bank in February-March. The occurrence on Georges intensifies in April and decreases in May. On Browns Bank, Stage III haddock eggs begin to appear in March-April and continue to be present throughout May and June. Generally, the Stage I, II and III CHW and CH eggs also followed this trend but with some differences. First there were more stations with CHW and CH egg occurrences so they tended to fill out the areas where the late Stage III haddock were found and even expanded into other parts of the survey area. Secondly, in February and sometimes March CHW and CH eggs were found at more locations than the late Stage III haddock eggs, in areas that were only later occupied by late Stage III haddock eggs.

In the first year, 1983, one sees the peak occurrence of Stage III haddock eggs in April and May. In April the haddock were distributed from Georges Bank to Browns Bank and surrounding areas but, by May, there is a clear separation between Georges and Browns Bank. The February survey indicates that spawning began on Georges Bank first while the June survey shows that spawning also ended on Georges Bank first. The distribution of Stage IV eggs was similar to the above. Larvae 1-7 mm long first occurred only on Georges Bank in April consistent with this location being the first to initiate spawning. By May larvae 1-7 mm long were detected both on Georges Bank and also in the Browns Bank/southwest Nova Scotia area. Larvae >7 mm were captured at two stations off southwest Nova Scotia in February and also in April and May on Georges, yet no larvae occurred in June or in the Browns Bank area.

The 1984 sampling season also observed Stage III haddock on Georges Bank in February and March with occurrences ending in May. The Browns Bank spawning was mainly detected in April and was present throughout May and June. The areas around Browns Bank contained Stage III eggs by May-June. The Stage IV egg distributions were similar to Stage III. On Georges Bank, Stage IV appeared in February, peaked in March and decreased to one occurrence in June. On Browns Bank, Stage IV appeared in April and was greatest in June. Larvae 1-7 mm long occurred principally in June on Browns Bank whereas their first occurrence was in March on Georges Bank and in April on Browns Bank. Unlike 1983, larvae >7 mm were found only on Browns Bank in June.

In the final year of sampling, 1985, Stage III haddock eggs were again observed first in February on Georges Bank and continued in March, April and May. The Browns Bank occurrences began in March but were mainly in April to June. In March, the eggs occurred mainly on the bank but by May the area east and west of the bank also had eggs. This description holds for Stage IV eggs and the larvae 1-7 mm long although for the larvae, the distributions were contracted. Larvae >7 mm were detected mainly on or near Browns Bank in June.

SSIP (Fig. 8.4.1-8.4.7)

The SSIP has good information on the intra-annual temporal variation of haddock egg and larvae distributions for the years, 1977-82. In contrast with the FEP, the spatial coverage was large, namely, the entire Scotian Shelf as opposed to the area covering Browns and Georges Bank. Thus, distances between stations were generally greater, as was the period between successive surveys.

The plots for Stage I, II and III CHW and CH eggs in each year had several features in common. Firstly, occurrences from August to December, no matter how numerous or widespread, could not be related to observations of late Stage III haddock eggs due to their virtual absence. Secondly, in the remaining months, spawning on Georges Bank appeared to precede spawning on Browns Bank, as was indicated by the FEP data. This signal was strongest with the Stage I and II CHW and CH eggs, which seemed to match the presence of Stage III haddock eggs more closely. By comparison, occurrences of Stage III haddock eggs on the Scotian Shelf were more commonly associated with the Stage III CHW and CH egg occurrences then with the earlier stages.

In the first year, 1977, samples were collected from mid-February to mid-October, with the majority of haddock occurrences in the February-March and April-May surveys. Stage I and II CHW and CH eggs were only coincident with these occurrences in February-March on Browns and Western Bank and were absent in April-May. The Stage III CHW and CH eggs differed from the earlier stages in that they were found more frequently and at more of the Stage III haddock egg sites. The Stage III and Stage IV haddock eggs appeared on Browns Bank and Emerald/Western/western Sable Island Bank in February-March. In April-May, Stage III eggs appeared offshore from Browns Bank to Banquereau. Stage IV eggs were more widely distributed. Larvae 1-7 mm long and >7 mm were only detected in April-May over the central Scotian Shelf.

In the following year, 1978, the samples were collected between mid-May and early September. Most of the few haddock eggs and larvae that were identified occurred in the May-July sampling period. The Stage III and Stage IV eggs were located on the two extreme ends of the Scotian Shelf. On the eastern extreme, Stage IV eggs were noticeably located on Misaine Bank. The earlier life stages, as represented by the Stage I and II CHW and CH eggs, were found in these regions but not always at the same sites, unlike the Stage III CHW and CH eggs which were coincident with almost every Stage III haddock egg location. The Stage III CHW and CH eggs were found at a large number of locations in the Misaine Bank area. Larvae could only be found on Georges Bank.

The temporal coverage in 1979 was much broader than in the previous 2 yr, extending from January 23 to December 5. A small number of locations with Stage III haddock eggs were present in April on the western extreme of the Scotian Shelf in contrast to the large number of Stage I, II and III CHW and CH eggs that ranged from Sable Island to Browns Bank. The occurrence of Stage III haddock eggs in May was also low yet spread over much of the Scotian Shelf. Stage I CHW and CH eggs had a similar density of occurrence over the same area but at different sites, in contrast to the Stage II and III CHW and CH eggs, which were coincident with the Stage III haddock egg sites and at a higher density of occurrence. Significant concentrations of Stage IV eggs were found in April in the Browns/Georges Bank and Emerald/Western/Sable Island Bank areas. In May, less stations were sampled but the Stage IV egg distribution was much the same. The larvae 1-7 mm long followed the same temporal and spatial pattern as the Stage IV eggs. Larvae >7 mm were not found in April but did occur in May on Baccaro and Emerald Bank in areas common to larvae 1-7 mm long found in April and May.

The 1980 sampling year ran from February 5 to October 29. However, no sampling was done in March and April. The first appearance of Stage III haddock eggs began in February on Georges then again in May on Browns Bank and Sable Island/Banquereau Bank. In June, eggs were still found on Browns/Baccaro Bank. The Stage I, II and III CHW and CH egg occurrences tended to coincide with the location of the Stage III haddock egg sites, but also occurred over a wider area as well. The number of these sites increased from Stage I to Stage III, especially on the eastern half of the Scotian Shelf in May. Many more Stage IV than Stage III haddock eggs were observed. The May distribution was a repeat of the previous year with eggs observed on Browns/Baccaro Bank, Emerald/Western/Sable Island Bank and areas north of Sable Island. One month later, eggs were only found on Emerald and Baccaro Bank with some near shore occurrences. Larvae 1-7 mm long first occurred in May over the western Scotian Shelf with foci on Browns and Emerald Bank. The June distribution was similar but more contracted. The larvae >7 mm matched the smaller larvae's distributions except that the June plot had more large larvae north and east of Browns Bank.

Unlike 1980, samples in 1981 were not taken between April and August. During March/April Stage III haddock eggs were found between Baccaro and Sable Island Bank with most on Emerald Bank. The greatest correspondence of the early life stages with the Stage III haddock egg locations occurred for the Stage II CHW and CH eggs. The Stage I CHW and CH egg locations were in a slightly different area than the Stage III haddock. Other time periods had no Stage III haddock eggs except for the single occurrence on Georges in February. Both the Stage IV eggs and 1- to 7-mm-long larvae were distributed like the Stage III eggs with the patches being more contracted. Larvae >7 mm could only be found on Emerald Bank.

The last year for sampling, 1982, had inconsistent spatial coverage. Sampling in the critical spawning months was limited to the western Scotian Shelf and no sampling occurred between January 28 and May 7. Stage III haddock eggs were found in January on Georges and Emerald Bank and in May off southwest Nova Scotia and Georges Bank. The Stage I, II and III CHW and CH eggs conformed to these locations, especially for the two older CHW and CH egg stages in May. Both Stage IV haddock eggs and 1- to 7-mm-long haddock larvae were observed on the western border of Browns Bank in May and by July were limited to a contracted patch over Browns Bank. Virtually no larvae >7 mm were found except for a single occurrence on Browns Bank in July.

SUMMARY

Fluctuations in the spatial and temporal occurrence of haddock from year to year, combined with the practicalities of attempting to sample a large geographic area on a frequent basis, result in noisy estimates of distribution. Hence, we aggregated the data from different ichthyoplankton monitoring programs that covered a variety of locations and time periods. This compositing filled in spatial and temporal holes and consequently helped to define the regional and temporal bounds of haddock spawning stocks in the Bay of Fundy and Scotian Shelf.

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Table 1. A brief overview of the temporal and spatial coverage of the ichthyoplankton surveys summarized in this report.

Program	Temporal coverage	Spatial range	Spatial coverage	NAFO area
LHP Bay of Fundy	1975-1984: 1 spring and 1 fall cruise/year 1977-1980: added 1 summer cruise/year 1985-1997: 1 fall cruise/year	Lat: 41°15'-45°58.38' N Long: 61°24.38'-68°07' W	Bay of Fundy Area off south-west Nova Scotia	Mostly 4X
LHP Georges Bank	1987-1997 1 fall cruise/year	Lat: 40°15'-45°46' N Long: 62°29.92'-68°59.43' W	Georges Bank	5Z 4X
FEP	1983-1985 Monthly, Feb.-Jun. (5 cruises/year)	Lat: 41°28.23'-45°10.62' N Long: 64°18.51'-67°21.09' W	Area off south-west Nova Scotia	4X only
SSIP	1976-1982 Spring, summer, fall, and winter cruises (4-7 cruises/year) 1976: 1 summer cruise only	Lat: 40°28.05'-47°10'00" N Long: 56°41.26'-65°30'30" W	Scotian Shelf, not including the Bay of Fundy	4V 4W 4X

Table 2. The survey dates and stations for all ichthyoplankton cruises conducted by the Larval Herring Program in the Bay of Fundy (survey type 3). Only the most recent cruises (e.g. N865) do not appear in the distribution plots. The number of stations sometimes exceeds the number of standard stations because of additional special sampling needs.

Cruise	Year	Start date (dd mm)	End date (dd mm)	Total sets	Total stations	Standard stations	Special stations						
							A[a]	R[b]	I[c]	T[d]	P[e]	N[f]	H[g]
P151	1975	02 Apr	11 Apr	129	129	113			16				
P217	1979	23 Mar	29 Mar	114	113	113							
P227	1979	08 Aug	16 Aug	162	143	143							
P250	1981	03 Mar	12 Mar	152	152	144			8				
P263	1981	10 Nov	22 Nov	151	151	143			8				
P268	1982	05 Mar	18 Mar	150	150	142			8				
P280	1982	27 Oct	07 Nov	170	160	143	3		14				
P287	1983	15 Mar	27 Mar	159	158	142			16				
P298	1983	01 Nov	12 Nov	156	156	146			10				
P301	1984	28 Feb	13 Mar	121	110	105			5				
P315	1984	02 Nov	14 Nov	179	173	152	9		12				
P329[h]	1985	22 Oct	13 Nov	242	162	146			16				
P344	1986	28 Oct	12 Nov	188	164	154			9		1		
P361	1987	21 Oct	11 Nov	188	163	154			9				
P377	1988	25 Oct	09 Nov	206	206	145		52	9				
P391	1989	25 Oct	08 Nov	226	225	150		50	9		11		5
P408	1990	25 Oct	06 Nov	158	154	132		18	4				
P422	1991	02 Nov	14 Nov	142	134	112			3		15		4
P437	1992	29 Oct	11 Nov	144	125	119			6				
P451	1993	24 Oct	04 Nov	124	124	115			6		3		
N211	1994	02 Nov	15 Nov	166	162	130			7	2	7	16	
N232	1995	01 Nov	13 Nov	125	100	92			2		4	2	
N252	1996	02 Nov	15 Nov	156	145	106			7	2	9	18	3
N765	1997	29 Oct	07 Nov	103	102	98			1	1	1	1	
N770	1997	19 Nov	21 Nov	107	97	84[i]							
N865	1998	28 Oct	09 Nov	135	128	113			2		5	5	3

[a] Special case additions (e.g. P280 - Canada/USA larval study; P329 – comparative tows with Lady Hammond)

[b] Random stations. [c] ICNAF stations. [d] Standard Halifax transect stations.

[e, f, g] Prince, Needler and Hammond stations, respectively. Named after first vessel to sample the station.

[h] Usual survey extended for intensive sampling of southwest Nova Scotia area (4 passes) during this cruise. Many stations sampled >= 2 times (Stephenson and Power 1989).

Table 3. The survey dates for all ichthyoplankton cruises appearing in the distribution plots and conducted by the Larval Herring Program on Georges Bank. The number of stations sometimes exceeds the number of standard stations because of additional special sampling needs.

Cruise	Year	Start date (dd mm)	End date (dd mm)	Total sets	Total stations	Standard stations	Special stations					
							A[a]	T[b]	N[c]	H[d]	F[e]	E[f]
H181	1987	24 Oct	09 Nov	140	48	48						
H195	1988	29 Oct	09 Nov	87	80	70	10					
H207	1989	26 Oct	08 Nov	129	101	95				6		
H222	1990	28 Oct	09 Nov	112	102	81					21	
H235	1991	02 Nov	10 Nov	97	93	74					19	
Z049	1992	24 Nov	30 Nov	86	86	86						
N195	1993	14 Nov	24 Nov	72	71	71						
N213	1994	16 Nov	28 Nov	106	104	99		4				1
N233	1995	17 Nov	28 Nov	113	110	101		5	4			

[a] Additional stations. [b] Standard Halifax transect stations. [c] Needler stations. [d] Hammond stations. [e] Fishing trawl stations with hydro data only. [f] Emerald Basin stations with hydro data only.

Table 4. Larval Herring Program ichthyoplankton cruises not appearing in the distribution plots. The number of stations sometimes exceeds the number of standard stations because of additional special sampling needs.

Cruise	Year	Start date (dd mm)	End date (dd mm)	Total sets	Total stations	Standard stations	Comments
P160	1975	05 Nov	13 Nov	100	91	87	Not known if sorted for haddock.
P163	1976	24 Mar	31 Mar	131	131	114	Not known if sorted for haddock.
P175	1976	10 Nov	17 Nov	124	116	110	Not known if sorted for haddock.
P180	1977	22 Mar	30 Mar	97	96	89	Not known if sorted for haddock.
P186	1977	09 Aug	16 Aug	132	132	115	Not known if sorted for haddock.
P190	1977	18 Oct	25 Oct	128	128	115	Not known if sorted for haddock.
P193	1978	15 Mar	01 Apr	113	113	113	Not known if sorted for haddock.
P202	1978	15 Aug	20 Aug	115	115	115	Not known if sorted for haddock.
P207	1978	01 Nov	07 Nov	115	115	115	Not known if sorted for haddock.
P226	1979	25 Jul	31 Jul	106	106	106	Not known if sorted for haddock.
P228	1979	20 Aug	26 Aug	116	116	116	Not known if sorted for haddock.
P232	1979	31 Oct	06 Nov	115	115	115	Not known if sorted for haddock.
P234	1980	04 Mar	13 Mar	111	111	111	Not known if sorted for haddock.
P243	1980	12 Aug	20 Aug	160	160	144	Not known if sorted for haddock.
P246	1980	03 Nov	12 Nov	131	131	122	Not known if sorted for haddock.
V710	1997	13 May	25 May	38	38	38	A Bras d'Or Lakes survey.
V778	1997	20 Jun	26 Jun	53	53	53	A Bras d'Or Lakes survey.

Table 5. Ichthyoplankton surveys that are considered part of the Scotian Shelf Ichthyoplankton Program data set but were not included in the present analyses. Information in this table obtained from Anon. (1989).

Cruise	Year	# oblique bongo tows	Comments
AP01	1980	79	• a joint Canada-USSR survey • sampling part of a patch study restricted to Emerald Bank
AP02	1980	27	• a joint Canada-USSR survey • sampling part of a patch study restricted to Emerald Bank
HO41	1980	229	• a joint Canada-USSR survey • sampling primarily a patch study on Emerald and Western Banks
AR01	1980	80	• a silver hake survey
AR02	1980	38	• a silver hake survey

Table 6. The survey dates for ichthyoplankton cruises appearing in the distribution plots and conducted by the Scotian Shelf Ichthyoplankton Program.

Cruise	Year	Start date (dd mm)	End date (dd mm)	Total sets	Total stations	Standard stations
P170	1976	12 Aug	24 Aug	76	76	76
CC01	1977	15 Feb	26 Mar	176	136	136
P182	1977	30 Apr	19 May	129	129	129
CL01	1977	8 Aug	2 Sep	159	159	159
FT01	1977	21 Sep	19 Oct	161	149	149
CC02	1978	17 May	14 Jul	395	199	199
VY01	1978	06 Aug	25 Aug	147	147	147
H005	1978	09 Aug	16 Aug	53	53	53
H006	1978	20 Aug	01 Sep	95	95	95
VY02	1978	29 Aug	15 Sep	149	148	148
H007	1978	06 Sep	08 Sep	20	20	20
H011	1979	23 Jan	02 Feb	37	37	37
H015	1979	02 Apr	25 Apr	124	124	124
H018	1979	14 May	31 May	78	78	78
VN01	1979	04 Aug	19 Aug	126	126	126
VN02	1979	24 Aug	10 Sep	125	125	125
H025	1979	24 Sep	12 Oct	91	91	91
H028	1979	13 Nov	05 Dec	118	118	118
H032	1980	05 Feb	28 Feb	95	95	95
H035	1980	07 May	29 May	138	138	138
H036	1980	03 Jun	26 Jun	153	153	153
BR02	1980	11 Jul	04 Aug	91	91	91
LE01	1980	15 Aug	31 Aug	130	130	130
LE02	1980	4 Sep	22 Sep	126	125	125
AR03	1980	02 Oct	29 Oct	122	122	122
H045	1980	20 Nov	14 Dec	100	100	100
H047	1981	22 Jan	19 Feb	156	156	156
H050	1981	24 Mar	14 Apr	109	109	109
EK01	1981	26 Aug	12 Sep	79	79	79
EK02	1981	16 Sep	09 Oct	99	99	99
H069	1982	07 Jan	28 Jan	46	46	46
P271	1982	07 May	20 May	35	35	35
P276	1982	13 Jul	05 Aug	97	97	97
EK04	1982	23 Sep	12 Oct	92	92	92

Table 7. The survey dates for ichthyoplankton cruises appearing in the distribution plots and conducted by the Fisheries Ecology Program.

Cruise	Year	Start date (dd mm)	End date (dd mm)	Total sets	Total stations	Standard stations
H091	1983	09 Feb	17 Feb	53	53	53
H093	1983	06 Mar	16 Mar	50	50	50
P288	1983	07 Apr	20 Apr	49	49	49
H097	1983	04 May	13 May	78	78	78
H099	1983	04 Jun	12 Jun	82	81	81
H112	1984	08 Feb	22 Feb	74	73	73
H114	1984	22 Mar	29 Mar	54	54	54
H116	1984	17 Apr	25 Apr	62	62	62
H118	1984	15 May	23 May	70	70	70
H120	1984	12 Jun	21 Jun	84	82	82
H130	1985	05 Feb	21 Feb	89	84	84
H132	1985	14 Mar	27 Mar	66	48	48
H133	1985	03 Apr	17 Apr	109	88	88
H135	1985	07 May	16 May	73	57	57
H137	1985	04 Jun	13 Jun	79	61	61

Table 8. Gear type and the number of samples collected and processed as part of the Larval Herring Program between 1975 and 1995 in the Bay of Fundy. For Gear/Tow Type, the numbers indicate the mesh size used, S indicates a starboard sample, P indicates a port sample.

Gear/Tow type	Total tows	Number of tows processed for fish and/or fish eggs	Proportion of total tows processed (%)
0.5m NET - Vertical			
64µm	466	0	0
253µm	529	120	22.68
BONGO (61cm) - ICNAF Double Oblique			
P505µm	1	0	0
S505µm	1	0	0
BONGO (61cm) - Surface			
P505µm	77	0	0
S505µm	77	0	0
BONGO (61cm) – Saw Tooth			
P333µm	91	83	91.21
P505µm	6061	4631	76.41
S333µm	1547	353	22.82
S505µm	4468	928	20.77
NEUSTON – Surface			
1179µm	468	3	0.64
ISAACS-KID – Saw Tooth			
S505µm	1	0	0
Total	13787	6118	44.38

Table 9. Gear type and the number of samples collected and processed as part of the Larval Herring Program between 1987 and 1995 on Georges Bank. For Gear/Tow Type, the numbers indicate the mesh size used, S indicates a starboard sample, P indicates the port sample. A fish processing code of 0 was considered to mean not processed.

Gear/Tow type	Total tows	Number of tows processed for fish and/or fish eggs	Proportion of total tows processed (%)
UNKNOWN (code 77) - Vertical			
53µm	145	115	79.31
BIONESS – Old Stepped Oblique			
333µm	169	131	77.51
BIONESS – Saw Tooth			
333µm	88	67	76.14
BONGO (20cm) – Saw Tooth			
P064µm	63	0	0
P333µm	2	0	0
S064µm	63	0	0
S333µm	2	0	0
BONGO (61cm) – ICNAF Double Oblique			
P505µm	25	22	88.00
S505µm	25	3	12.00
BONGO (61cm) – Saw Tooth			
P064µm	1	0	0
P333µm	726	215	29.61
P505µm	524	387	73.85
S064µm	1	0	0
S333µm	1134	270	23.81
S505µm	93	1	1.07
BONGO (61cm) – Saw Tooth Vertical Profile			
P333µm	6	0	0
S333µm	6	0	0
Total	3073	1211	39.41

Table 10. Gear type and the number of samples collected and processed as part of the Fisheries Ecology Program between 1983 and 1985. For Gear/Tow Type, the numbers indicate the mesh size used, S indicates a starboard sample, P indicates the port sample and MARMAP stands for Marine Resources, Monitoring, Assessment and Prediction.

Gear/Tow type	Total tows	Number of tows processed for fish and/or fish eggs	Proportion of total tows processed (%)
1m NET – Vertical			
64µm	199	0	0
80µm	48	0	0
120µm	138	0	0
202µm	3	0	0
253µm	5	0	0
BONGO (61cm) - MARMAP Double Oblique			
S080µm	20	0	0
P165µm	189	0	0
S165µm	57	0	0
P333µm	1586	1442	90.92
S333µm	1698	787	46.35
BONGO (61cm) - Surface			
S165µm	6	0	0
P333µm	1043	1021	97.89
S333µm	1037	56	5.40
Total	6029	3306	54.83

Table 11. Gear type and the number of samples collected and processed as part of the Scotian Shelf Ichthyoplankton Program between 1976 and 1982. For Gear/Tow Type, the numbers indicate the mesh size used, S indicates a starboard sample, P indicates the port sample and MARMAP stands for Marine Resources, Monitoring, Assessment and Prediction.

Gear/Tow type	Total tows	Number of tows processed for fish and/or fish eggs	Proportion of total tows processed (%)
1m NET – Surface			
471µm	618	610	98.71
BONGO (61cm) – MARMAP Double Oblique			
P333µm	2818	2392	84.88
S333µm	2321	388	16.72
S471µm	497	0	0
BONGO (61cm) – Old Stepped Oblique			
P333µm	151	0	0
P471µm	864	367	42.48
S333µm	151	151	100
S471µm	864	460	53.24
BONGO (61cm) – Surface			
P333µm	1950	1785	91.54
S333µm	1950	133	6.82
NEUSTON – Surface			
333µm	176	172	97.73
1179µm	3422	3368	98.42
ISAACS-KIDD - MARMAP Double Oblique			
471µm	117	115	98.29
ISAACS-KIDD - Old Stepped Oblique			
471µm	1616	1561	96.60
ISAACS-KIDD – New Stepped Oblique			
471µm	540	527	97.59
SAMEOTO BOX NEUSTON - Surface			
405µm	251	251	100
Total	18306	12280	67.08

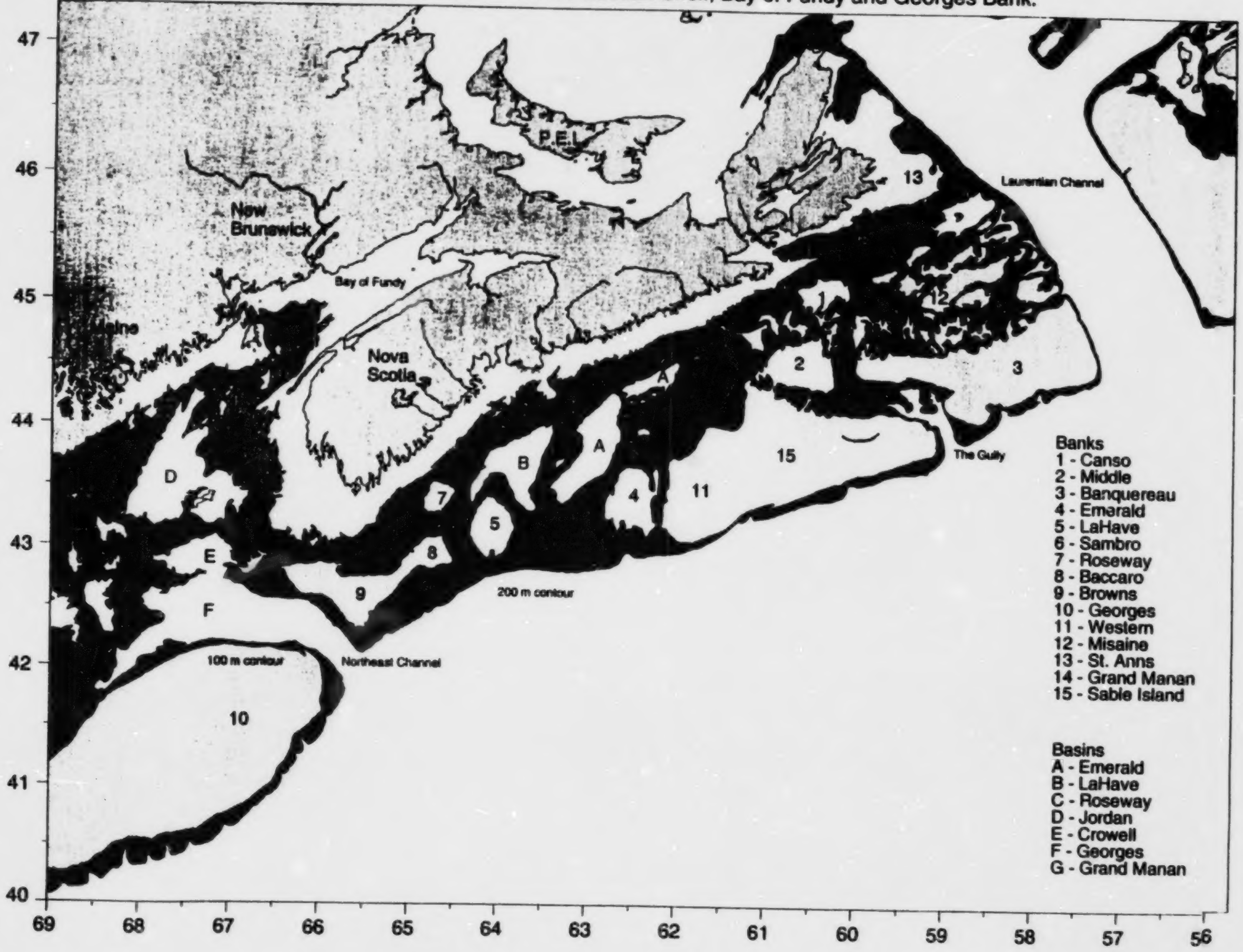
Table 12. Definition of the developmental stages of fish eggs as defined by Markle and Frost (1985).

Egg stage	Stage definition	Identification of cod, haddock and witch flounder
Stage I	from spawning until the visible formation of an embryonic axis about the mid gastrula	cod, haddock and witch cannot be distinguished
Stage II	from the end of stage I until the embryo is half way around the yolk sac, which corresponds approximately to the time of blastopore closure	cod, haddock and witch cannot be distinguished
Stage III	from the end of stage II until the tip of the tail reaches or could reach the snout	cod, haddock and witch can sometimes be distinguished, particularly in the latter portion of this stage
Stage IV	from the end of stage III until hatching	cod, haddock and witch can all be distinguished

Table 13. Initial processing codes for fish eggs, larvae and juveniles.

Code	Description
1	Identified and counted all fish and all fish eggs.
2	Identified and counted all fish and selected fish eggs.
3	Identified and counted all fish and no fish eggs.
4	Identified and counted selected fish and all fish eggs.
5	Identified and counted selected fish and selected fish eggs.
6	Identified and counted selected fish and no fish eggs.
7	Identified and counted no fish and all fish eggs.
8	Identified and counted no fish and selected fish eggs.
9	Identified and counted no fish and no fish eggs.
10	Sample lost in transit.
11	Sample rotten.
12	Sample hit bottom (full of sediment), not sorted.
13	Sample damaged while sorting.
14	Sample not sorted at present.
15	Sample not representative (tampered with or spilled).
16	Sorting information not available.

Fig. 1. Location of major physiographic features on the Scotian Shelf, Bay of Fundy and Georges Bank.


47
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59
58
57
56
New Brunswick
P.E.I.
Maine
Bay of Fundy
Nova Scotia
Laurentian Channel
The Gully
200 m contour
100 m contour
Northeast Channel
1
2
3
4
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13
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A
A
B
D
E
F
Banks
1 - Canso
2 - Middle
3 - Banquereau
4 - Emerald
5 - LaHave
6 - Sambro
7 - Roseway
8 - Baccaro
9 - Browns
10 - Georges
11 - Western
12 - Misaine
13 - St. Anns
14 - Grand Manan
15 - Sable Island
Basins
A - Emerald
B - LaHave
C - Roseway
D - Jordan
E - Crowell
F - Georges
G - Grand Manan

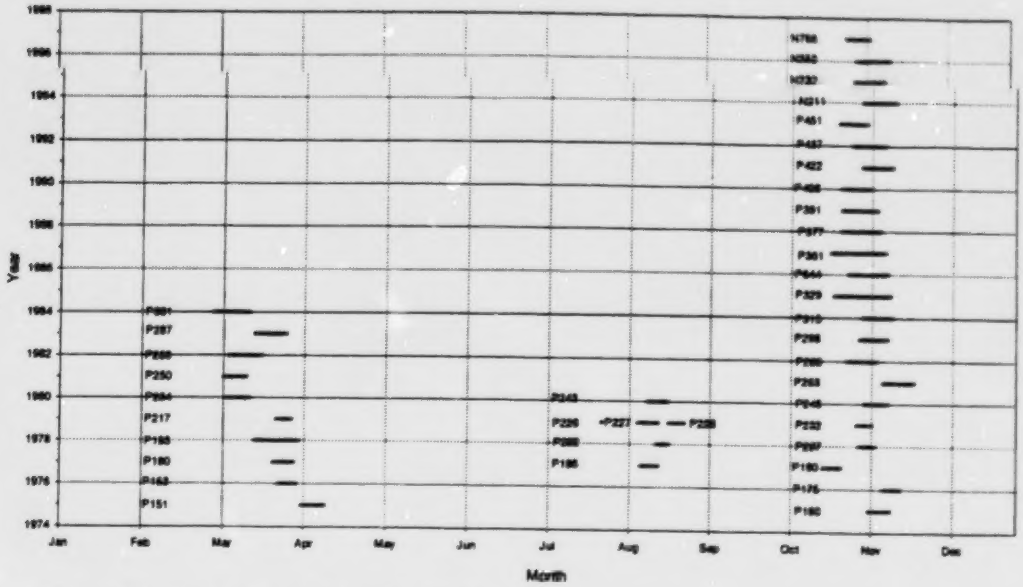


Fig. 2. Temporal coverage for LHP Bay of Fundy Cruises 1975 - 1997.

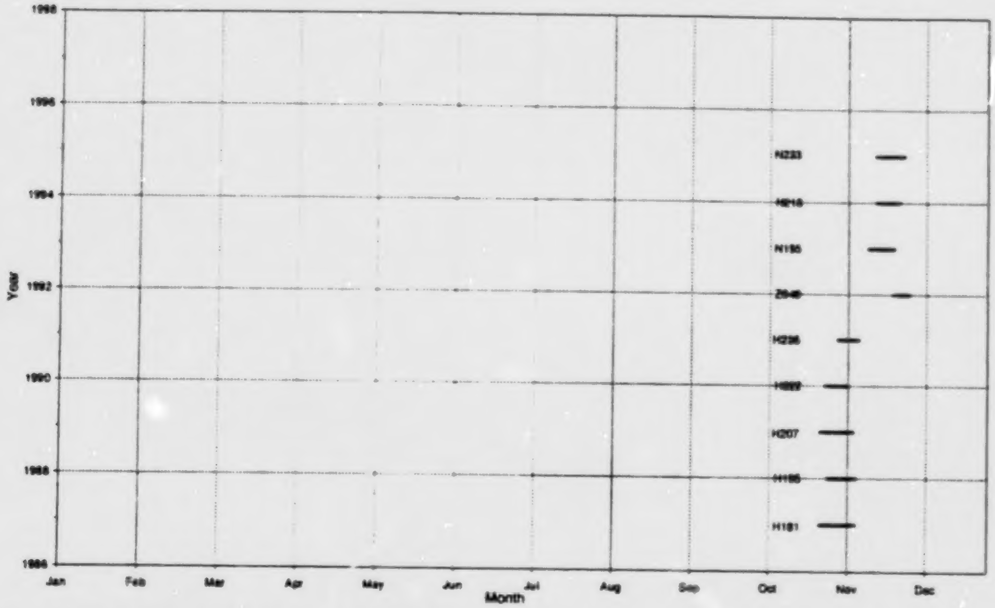


Fig. 3. Temporal coverage for LHP Georges Bank Cruises 1987 - 1995.

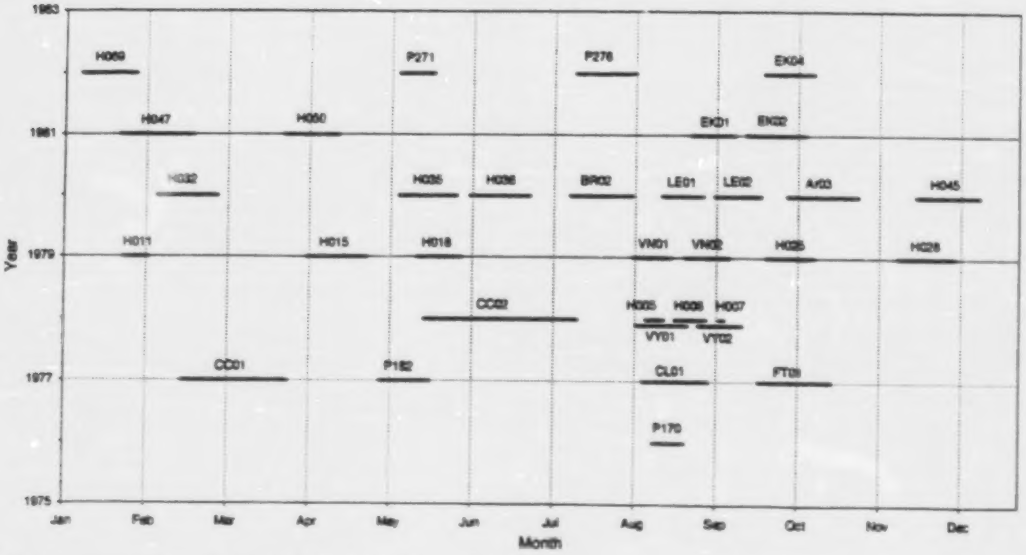


Fig. 4. Temporal coverage for SSIP Cruises 1976 - 1982.

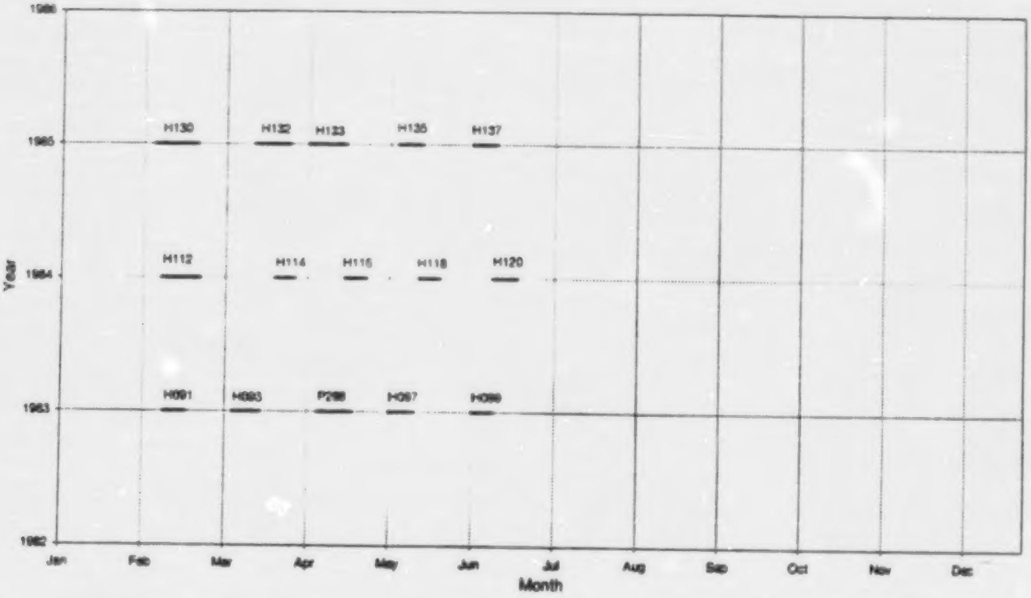


Fig. 5. Temporal coverage for FEP Cruises 1983 - 1985.

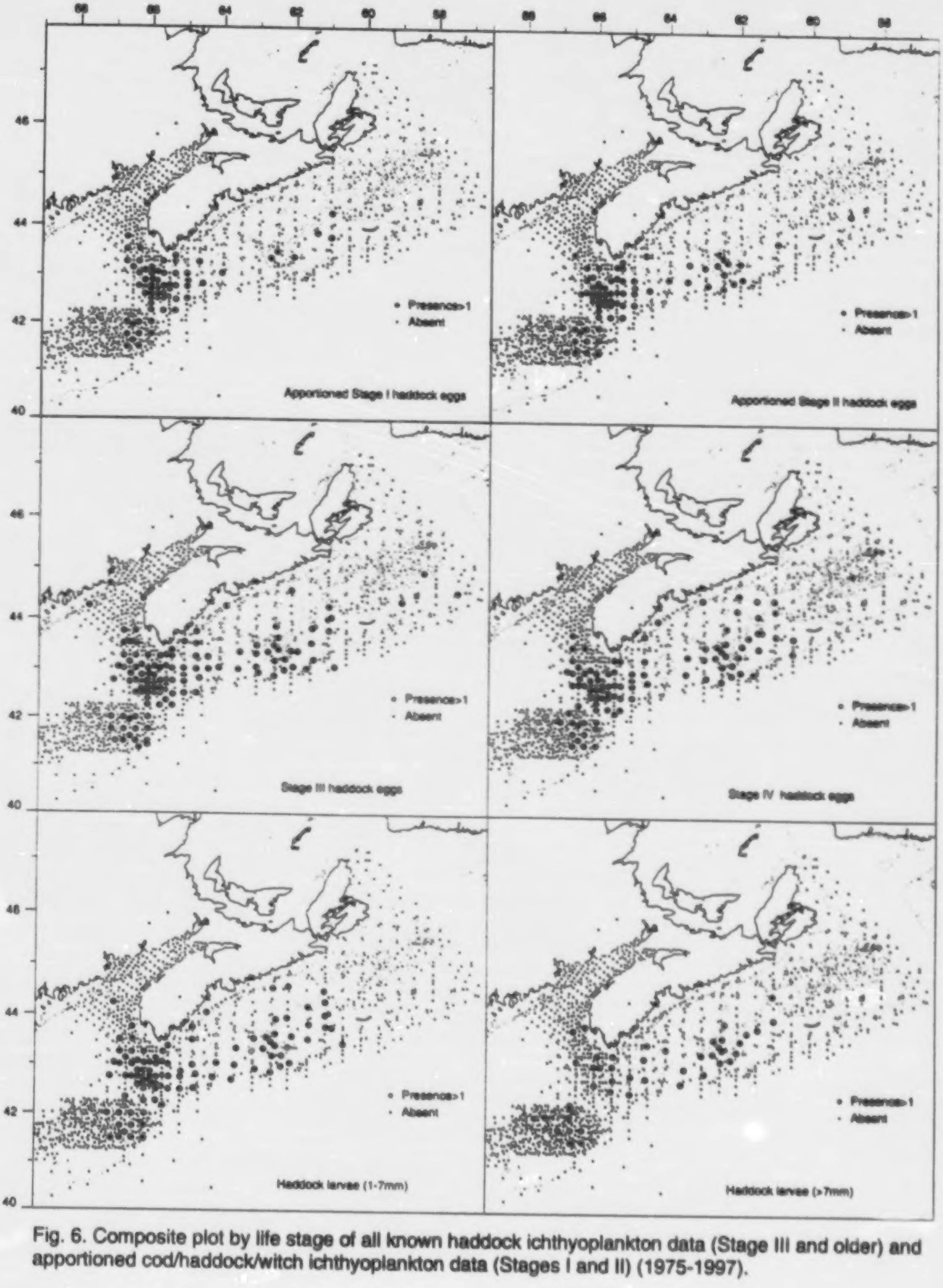

68
66
64
62
60
58
46
44
42
40
Presence>1
Absent
Apportioned Stage I haddock eggs
Apportioned Stage II haddock eggs
Stage III haddock eggs
Stage IV haddock eggs
Haddock larvae (1-7mm)
Haddock larvae (>7mm)

Fig. 6. Composite plot by life stage of all known haddock ichthyoplankton data (Stage III and older) and apportioned cod/haddock/witch ichthyoplankton data (Stages I and II) (1975-1997).

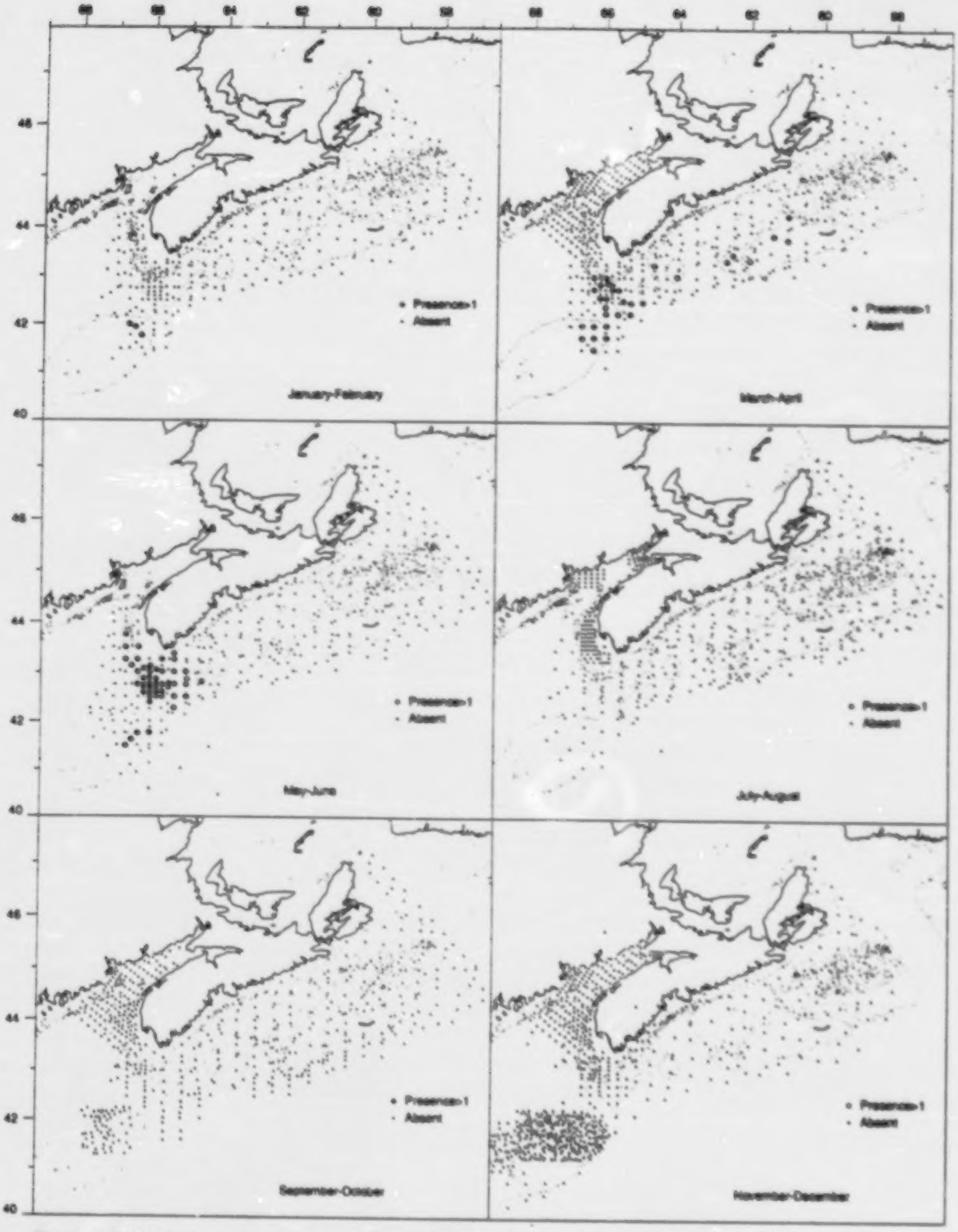

46
44
42
40
Presence>1
Absent
January-February
March-April
May-June
July-August
September-October
November-December

Fig. 7.1. Bimonthly composite plots of Stage I apportioned cod/haddock/witch eggs for stations sampled in all years and all programs (1975-1997).

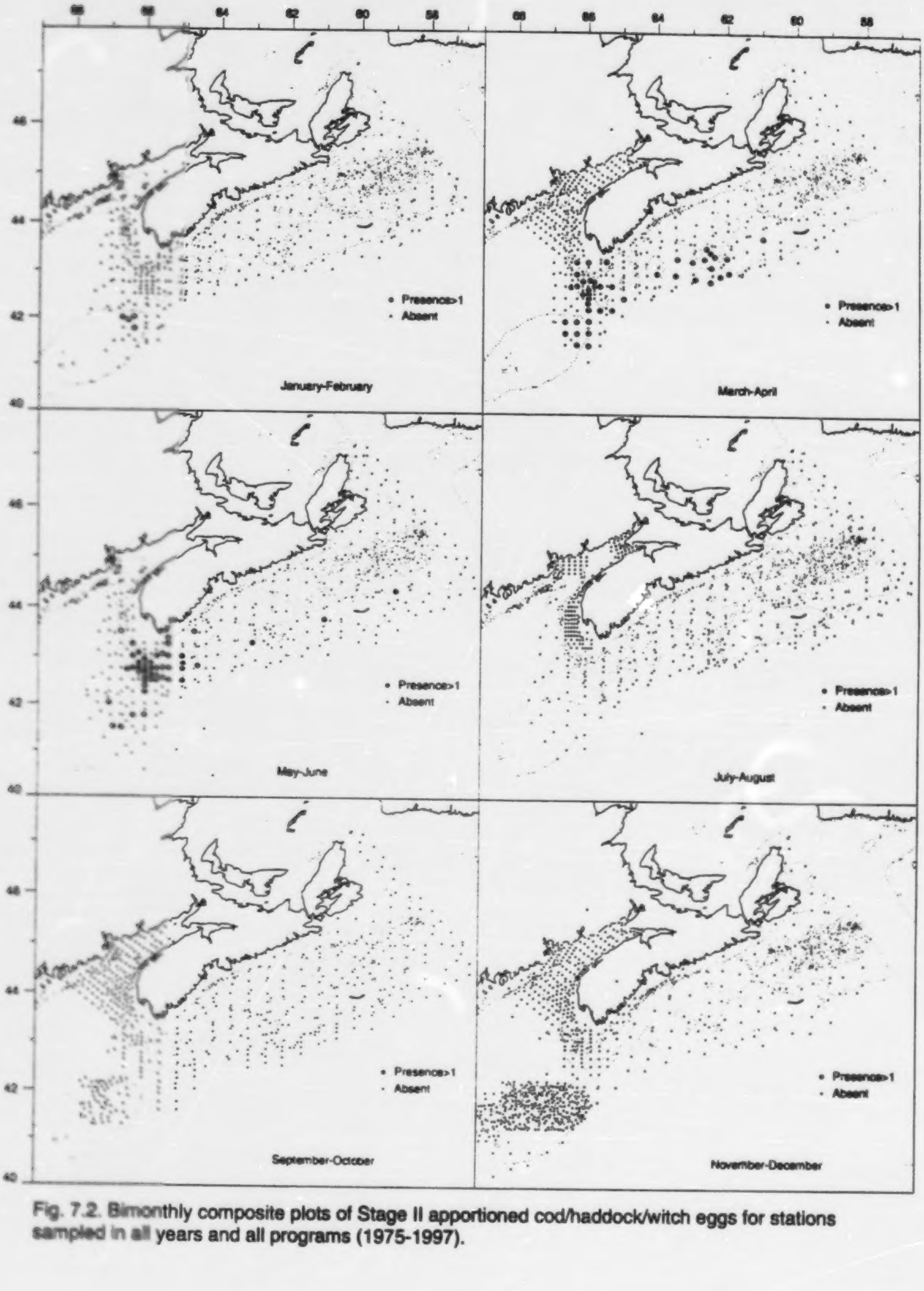

68
66
64
62
60
58
46
44
42
40
Presence>1
Absent
January-February
March-April
May-June
July-August
September-October
November-December

Fig. 7.2. Bimonthly composite plots of Stage II apportioned cod/haddock/witch eggs for stations sampled in all years and all programs (1975-1997).

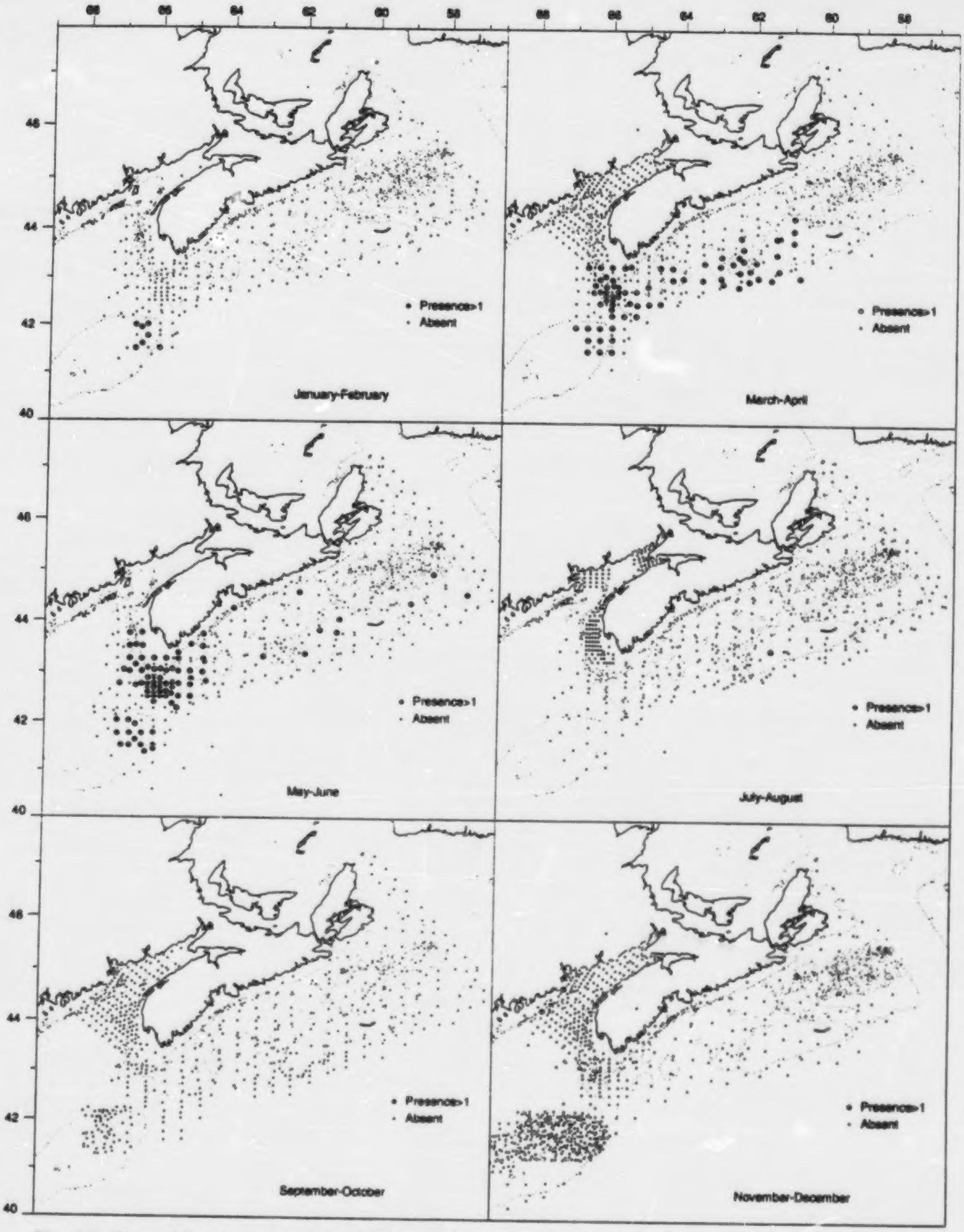

68
66
64
62
60
58
46
44
42
40
Presence>1
Absent
January-February
March-April
May-June
July-August
September-October
November-December

Fig. 7.3. Bimonthly composite plots of Stage III haddock eggs for stations sampled in all years and all programs (1975-1997).

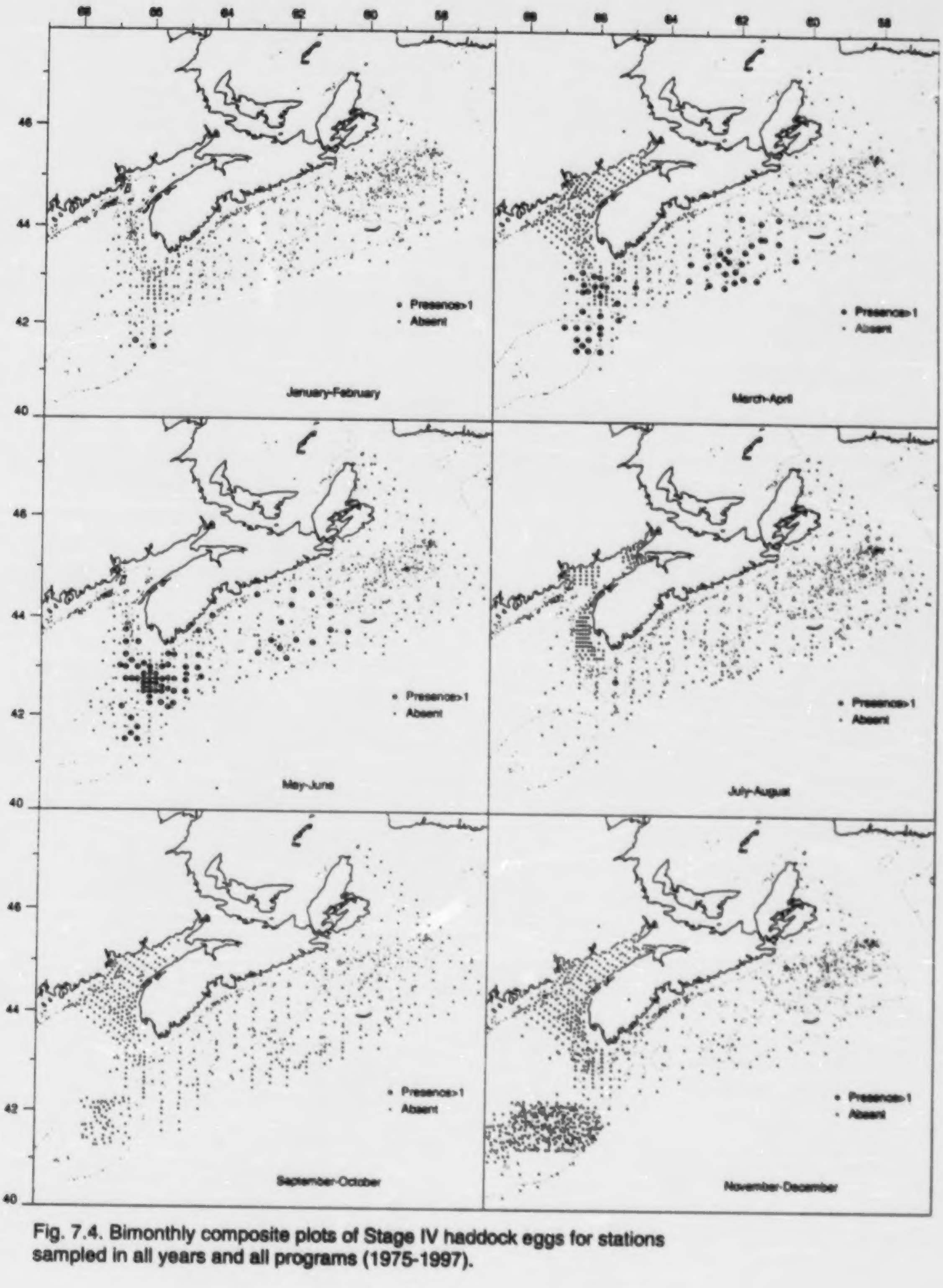

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
Presence>1
Absent
January-February
Presence>1
Absent
March-April
Presence>1
Absent
May-June
Presence>1
Absent
July-August
Presence>1
Absent
September-October
Presence>1
Absent
November-December

Fig. 7.4. Bimonthly composite plots of Stage IV haddock eggs for stations sampled in all years and all programs (1975-1997).

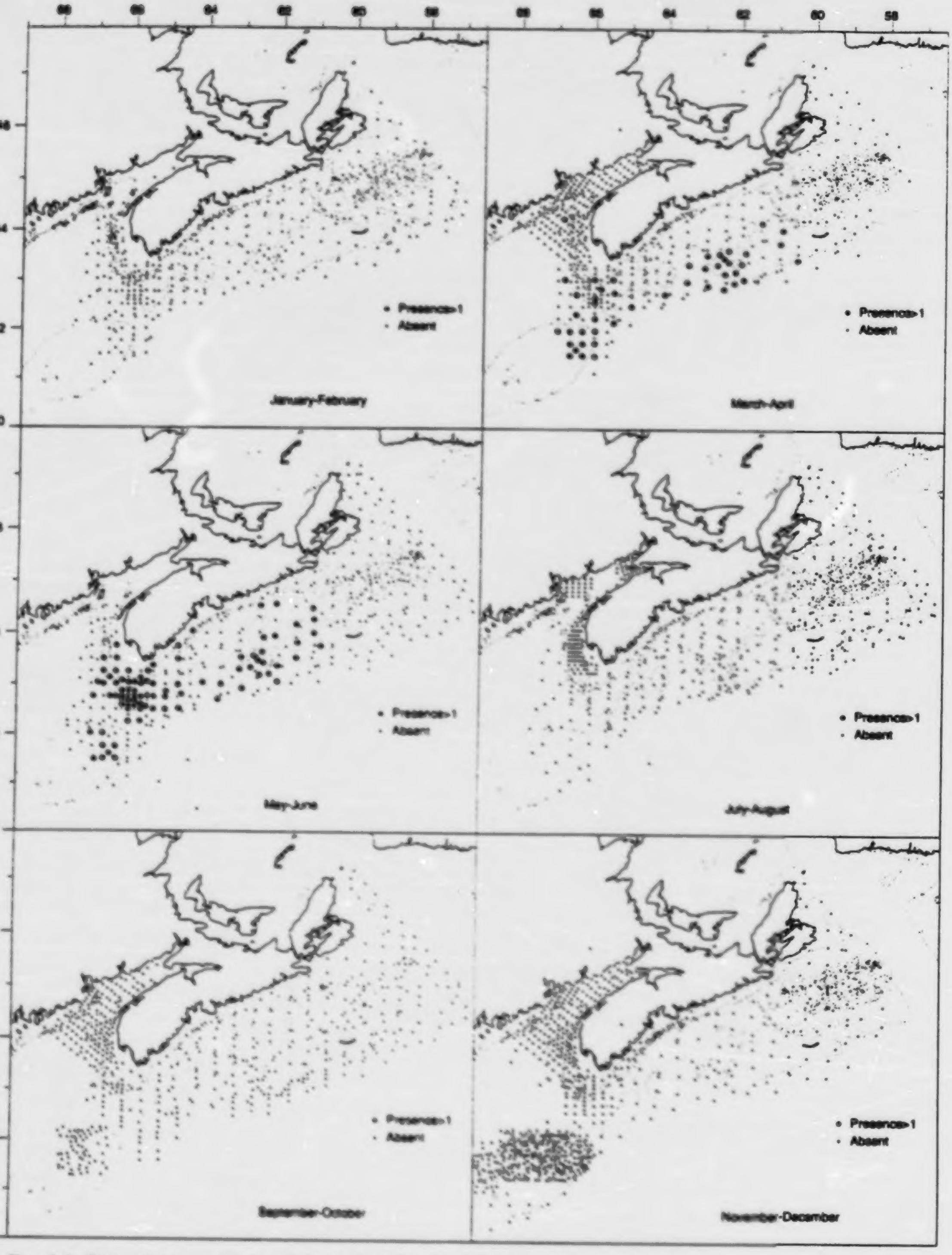

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
Presence>1
Absent
January-February
March-April
May-June
July-August
September-October
November-December

Fig. 7.5. Bimonthly composite plots of haddock larvae (1-7mm) for stations sampled in all years and all programs (1975-1997).

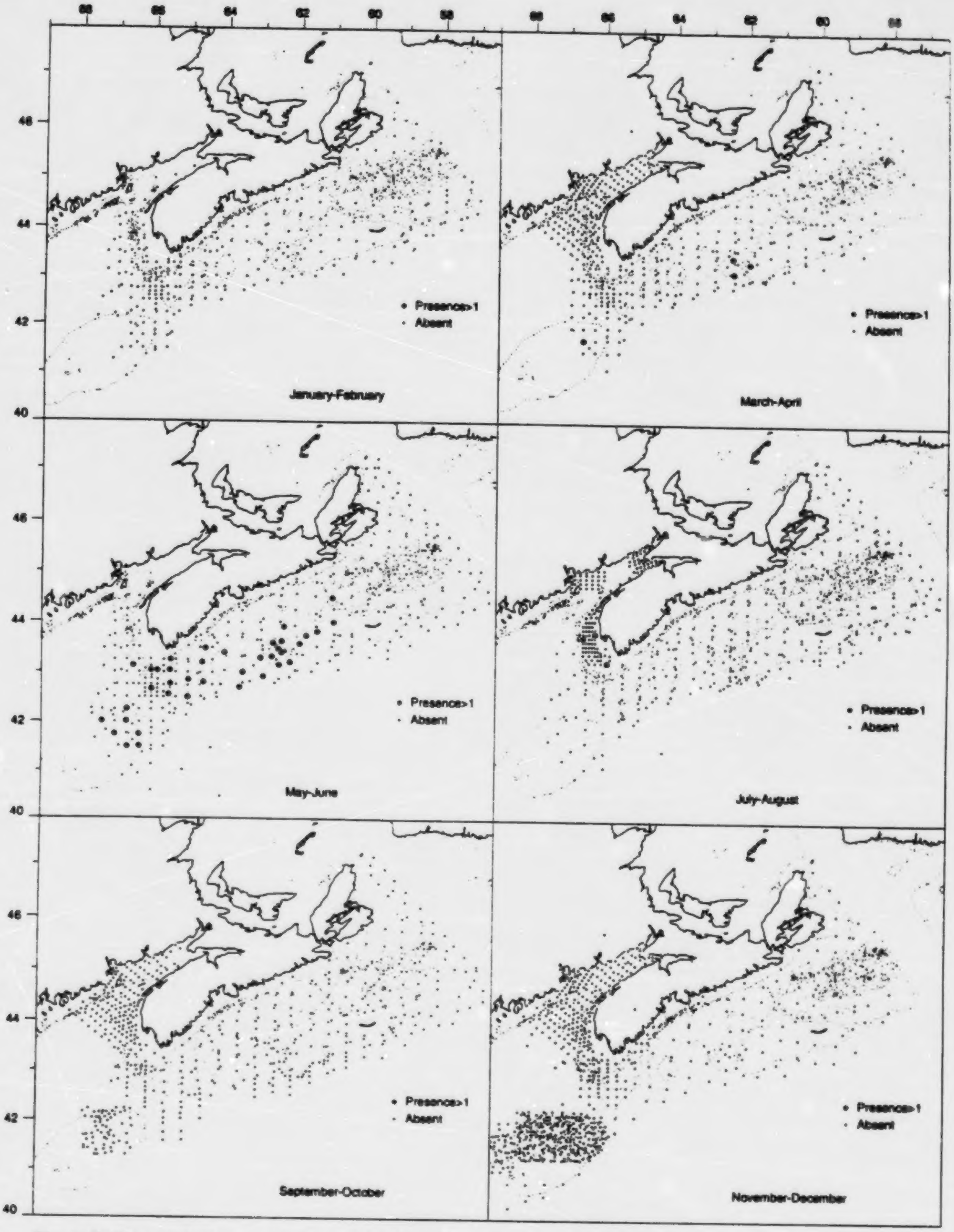

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
Presence>1
Absent
January-February
Presence>1
Absent
March-April
46
44
42
40
Presence>1
Absent
May-June
Presence>1
Absent
July-August
46
44
42
40
Presence>1
Absent
September-October
Presence>1
Absent
November-December

Fig. 7.6. Bimonthly composite plots of haddock larvae (>7mm) for stations sampled in all years and all programs (1975-1997).

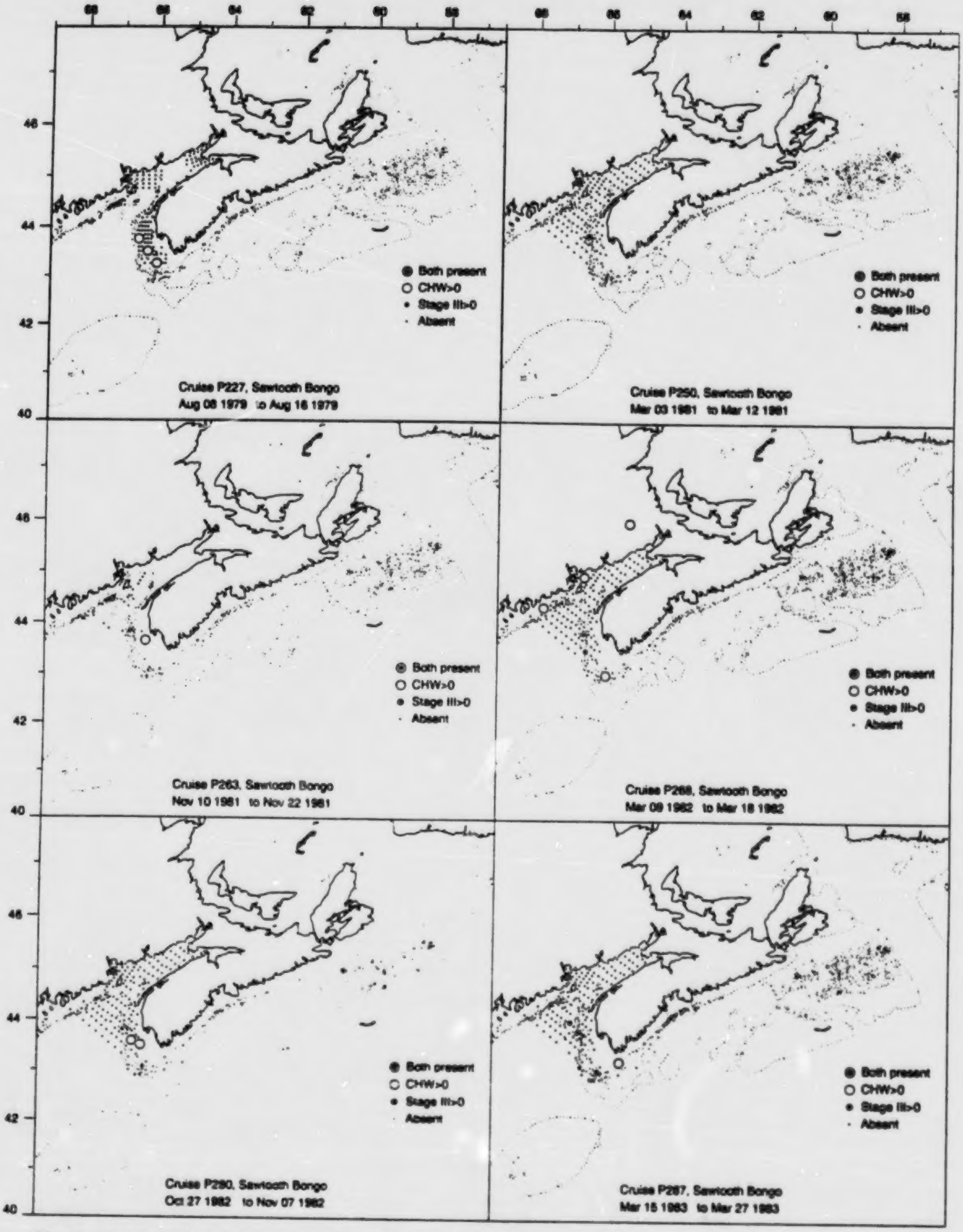

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise P227, Sawtooth Bongo
Aug 08 1979 to Aug 16 1979
Cruise P250, Sawtooth Bongo
Mar 03 1981 to Mar 12 1981
Cruise P263, Sawtooth Bongo
Nov 10 1981 to Nov 22 1981
Cruise P268, Sawtooth Bongo
Mar 09 1982 to Mar 18 1982
Cruise P280, Sawtooth Bongo
Oct 27 1982 to Nov 07 1982
Cruise P287, Sawtooth Bongo
Mar 15 1983 to Mar 27 1983

Fig. 8.1.1. Larval Herring Program-Bay of Fundy Cruises: Stage I CHW and Stage III haddock eggs.

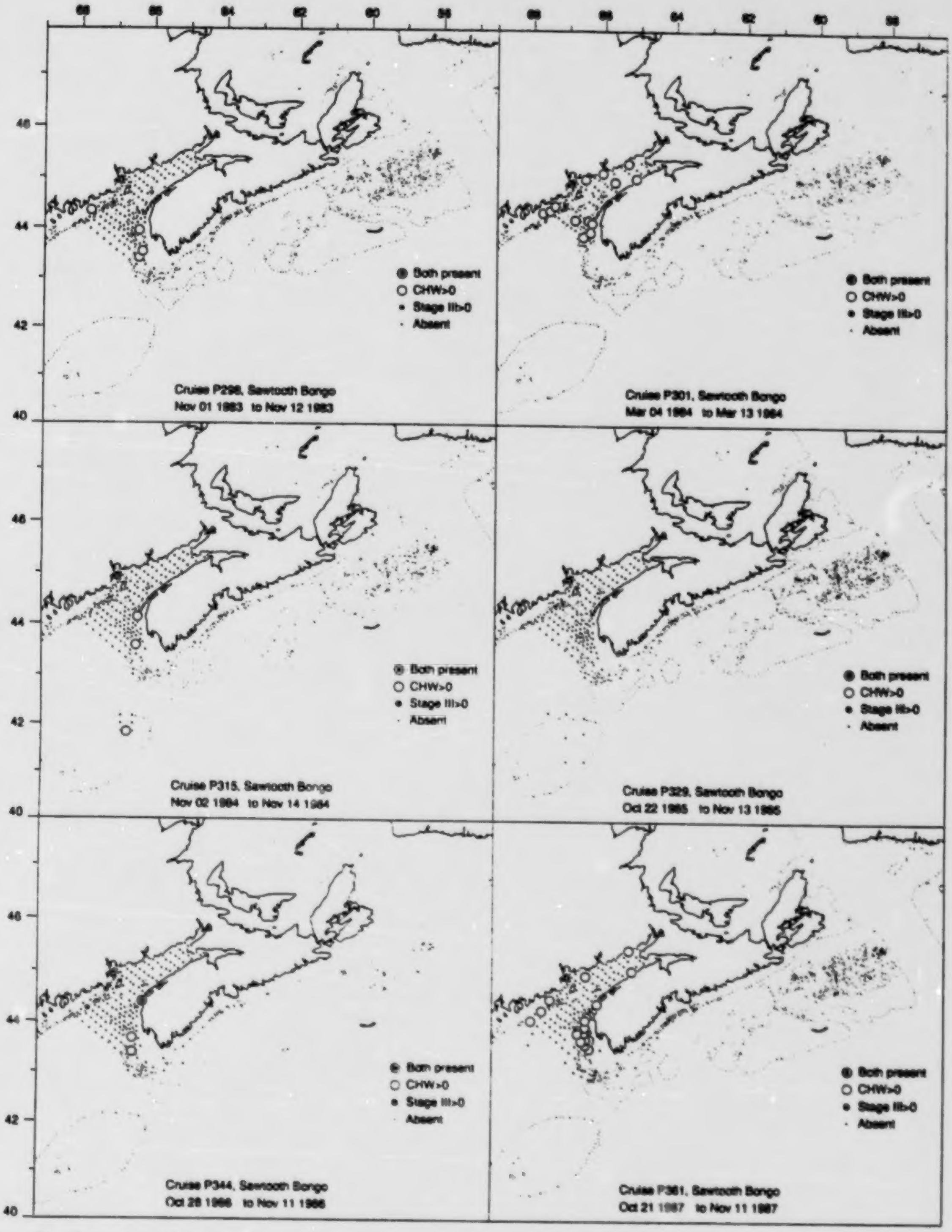

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P298, Sawtooth Bongo
Nov 01 1983 to Nov 12 1983
Cruise P301, Sawtooth Bongo
Mar 04 1984 to Mar 13 1984
Cruise P315, Sawtooth Bongo
Nov 02 1984 to Nov 14 1984
Cruise P329, Sawtooth Bongo
Oct 22 1985 to Nov 13 1985
Cruise P344, Sawtooth Bongo
Oct 28 1986 to Nov 11 1986
Cruise P361, Sawtooth Bongo
Oct 21 1987 to Nov 11 1987

Fig. 8.1.1. (continued).

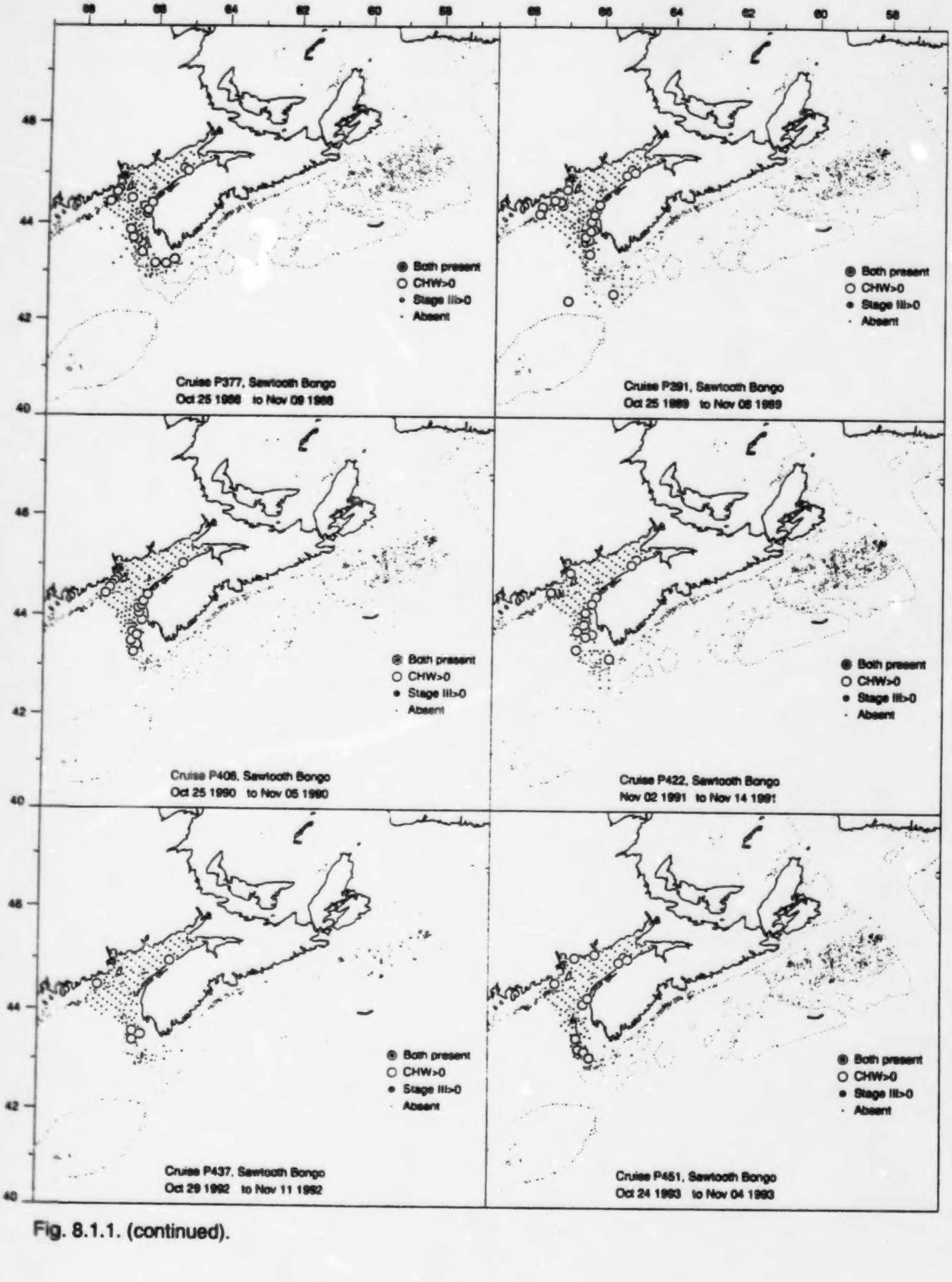

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P377, Sawtooth Bongo
Oct 25 1988 to Nov 09 1988
Cruise P391, Sawtooth Bongo
Oct 25 1989 to Nov 08 1989
Cruise P406, Sawtooth Bongo
Oct 25 1990 to Nov 05 1990
Cruise P422, Sawtooth Bongo
Nov 02 1991 to Nov 14 1991
Cruise P437, Sawtooth Bongo
Oct 29 1992 to Nov 11 1992
Cruise P451, Sawtooth Bongo
Oct 24 1993 to Nov 04 1993

Fig. 8.1.1. (continued).

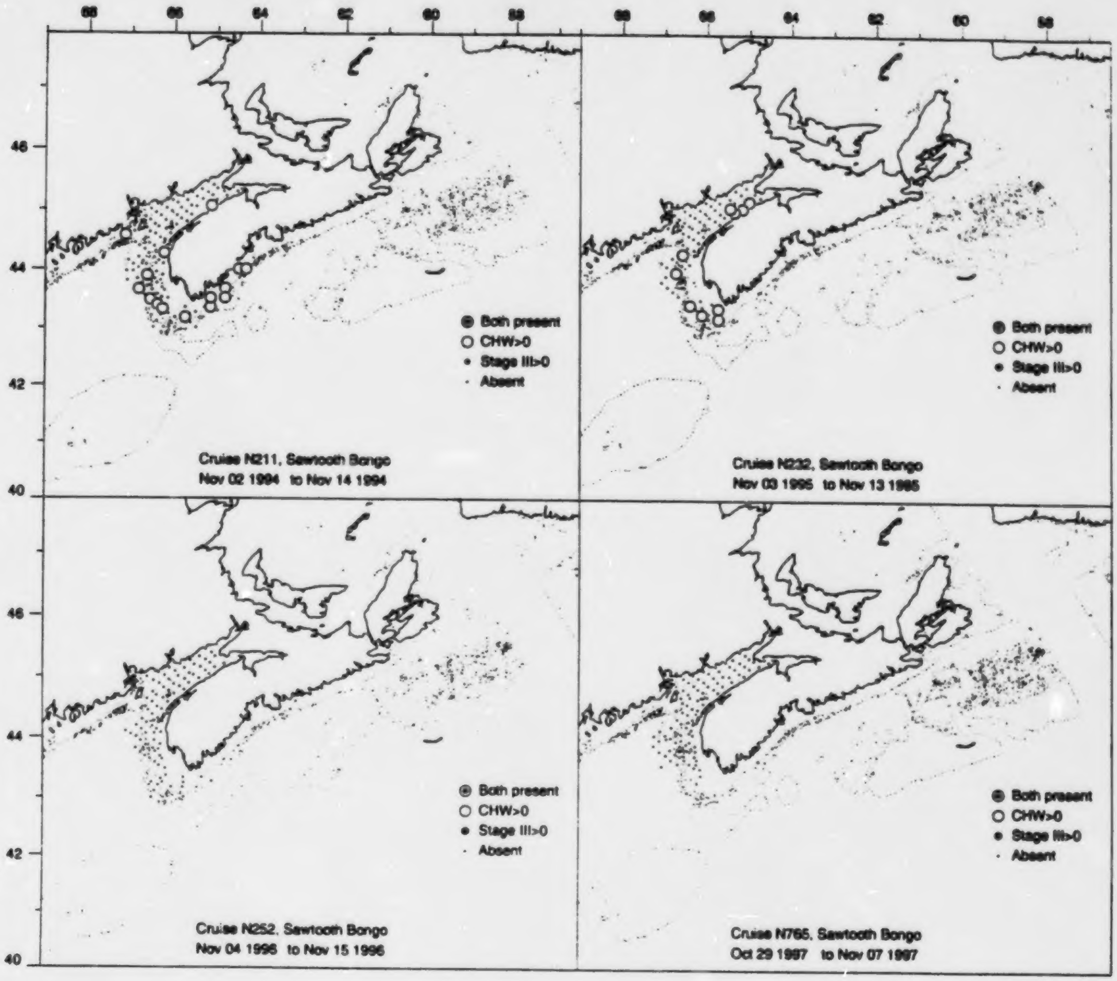

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise N211, Sawtooth Bongo
Nov 02 1994 to Nov 14 1994
Cruise N232, Sawtooth Bongo
Nov 03 1995 to Nov 13 1995
Cruise N252, Sawtooth Bongo
Nov 04 1996 to Nov 15 1996
Cruise N765, Sawtooth Bongo
Oct 29 1997 to Nov 07 1997

Fig. 8.1.1. (continued).

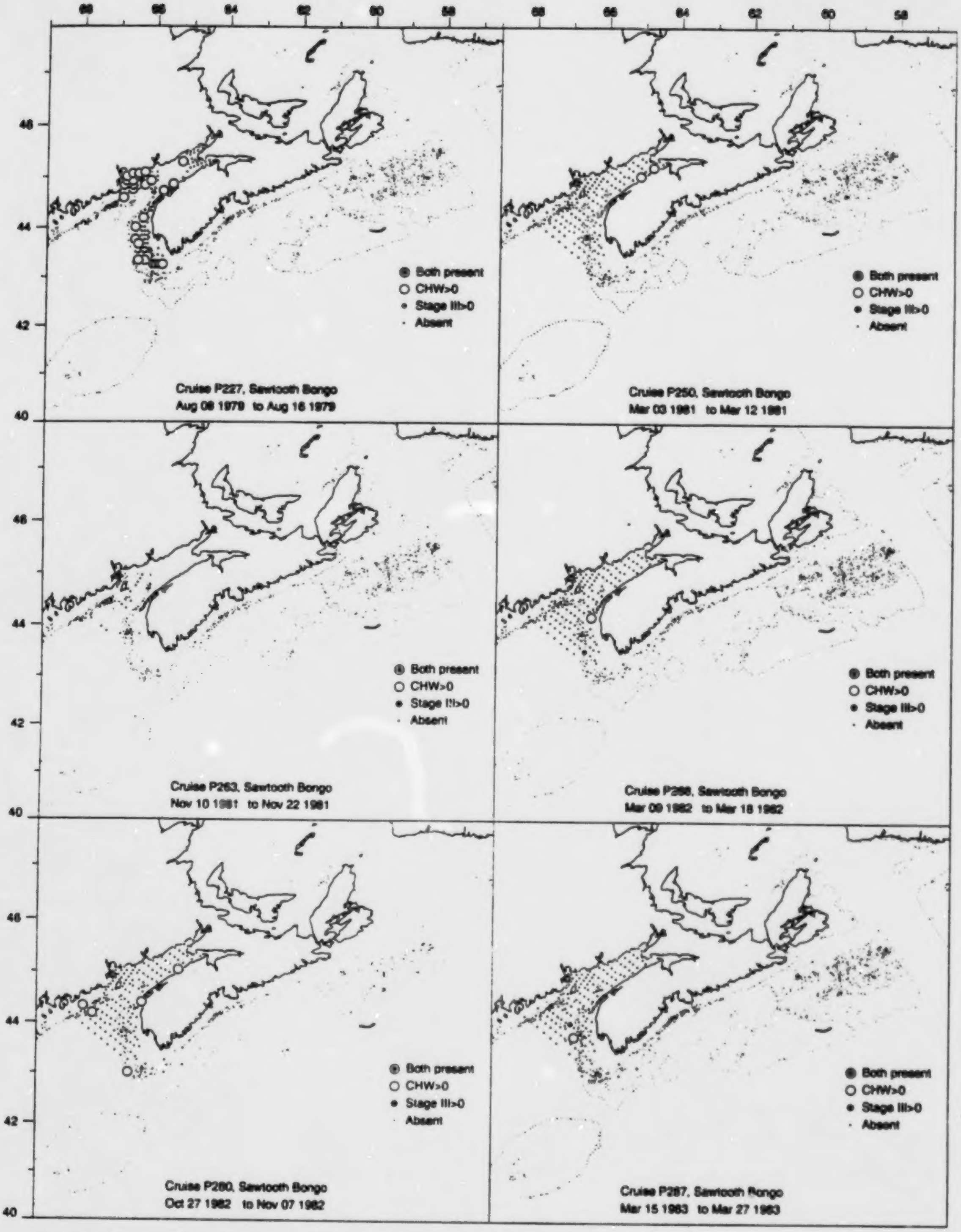

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P227, Sawtooth Bongo
Aug 08 1979 to Aug 16 1979
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P250, Sawtooth Bongo
Mar 03 1981 to Mar 12 1981
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P263, Sawtooth Bongo
Nov 10 1981 to Nov 22 1981
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P268, Sawtooth Bongo
Mar 09 1982 to Mar 18 1982
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P280, Sawtooth Bongo
Oct 27 1982 to Nov 07 1982
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P287, Sawtooth Bongo
Mar 15 1983 to Mar 27 1983

Fig. 8.1.2. Larval Herring Program-Bay of Fundy Cruises: Stage II CHW and Stage III haddock eggs.

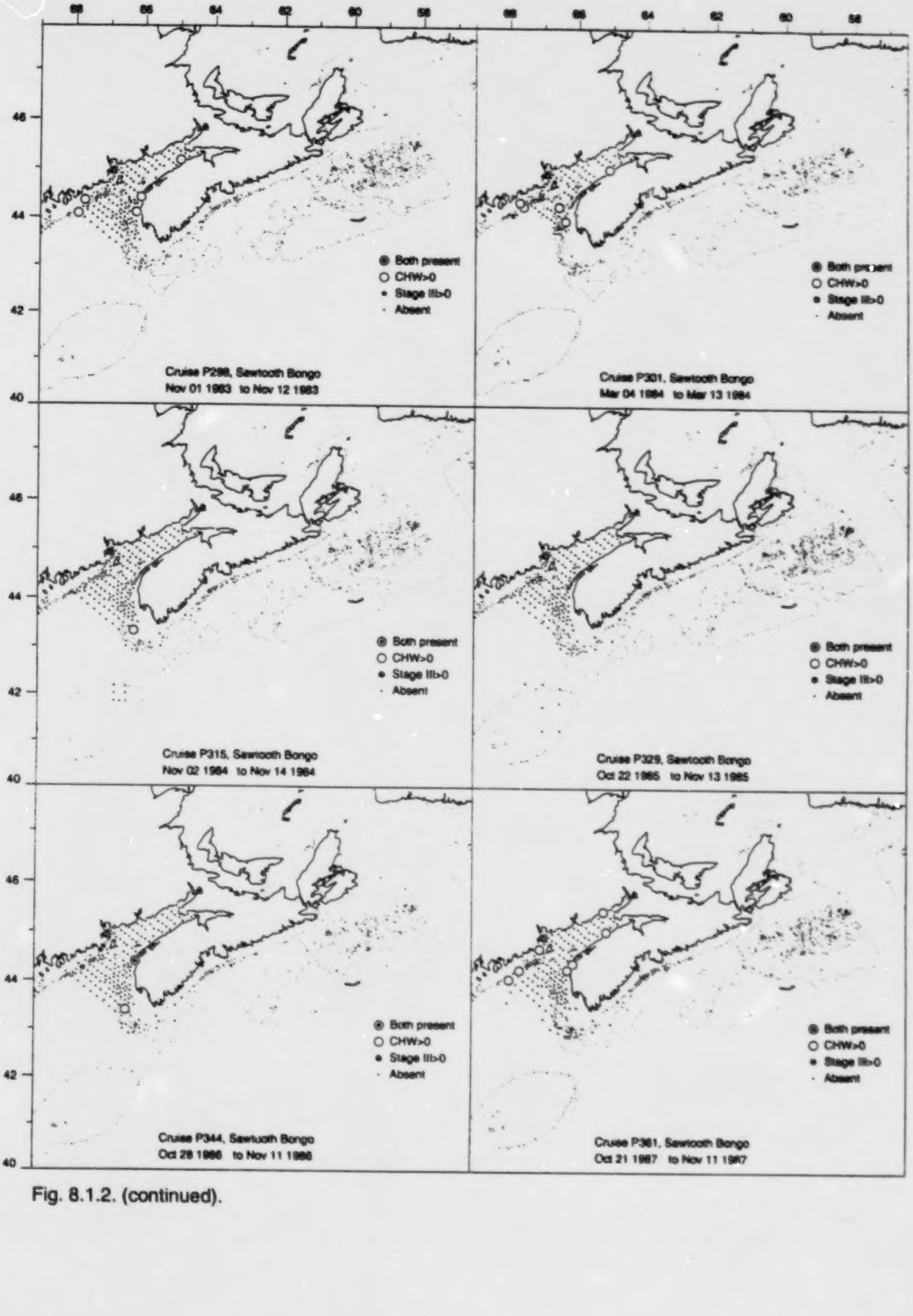

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage IIb>0
Absent
Cruise P298, Sawtooth Bongo
Nov 01 1983 to Nov 12 1983
Cruise P301, Sawtooth Bongo
Mar 04 1984 to Mar 13 1984
Cruise P315, Sawtooth Bongo
Nov 02 1984 to Nov 14 1984
Cruise P329, Sawtooth Bongo
Oct 22 1985 to Nov 13 1985
Cruise P344, Sawtuoth Bongo
Oct 28 1986 to Nov 11 1986
Cruise P361, Sawtooth Bongo
Oct 21 1987 to Nov 11 1987

Fig. 8.1.2. (continued).

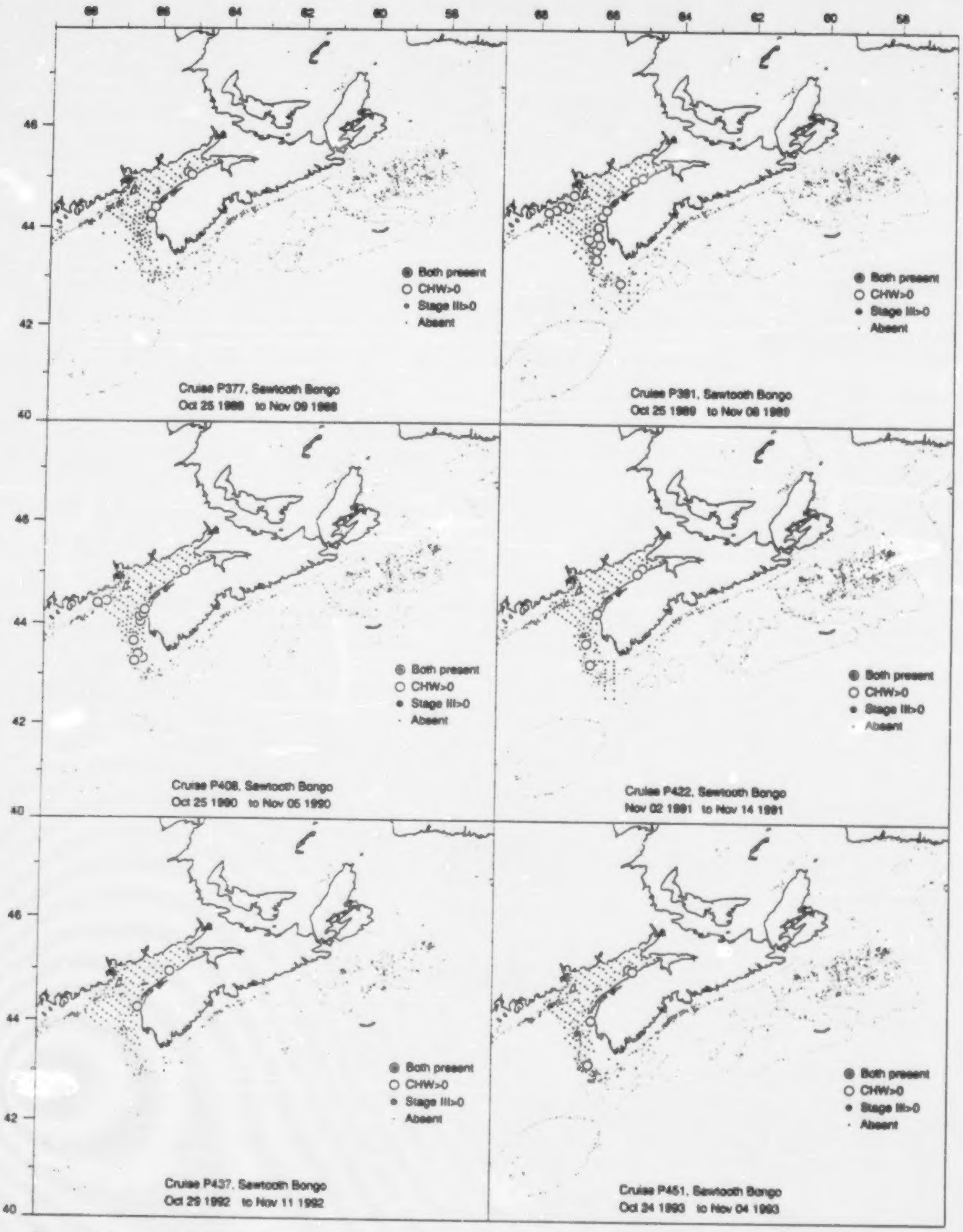

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise P377, Sawtooth Bongo
Oct 25 1988 to Nov 09 1988
Cruise P391, Sawtooth Bongo
Oct 25 1989 to Nov 08 1989
Cruise P408, Sawtooth Bongo
Oct 25 1990 to Nov 05 1990
Cruise P422, Sawtooth Bongo
Nov 02 1991 to Nov 14 1991
Cruise P437, Sawtooth Bongo
Oct 29 1992 to Nov 11 1992
Cruise P451, Sawtooth Bongo
Oct 24 1993 to Nov 04 1993

Fig. 8.1.2. (continued).

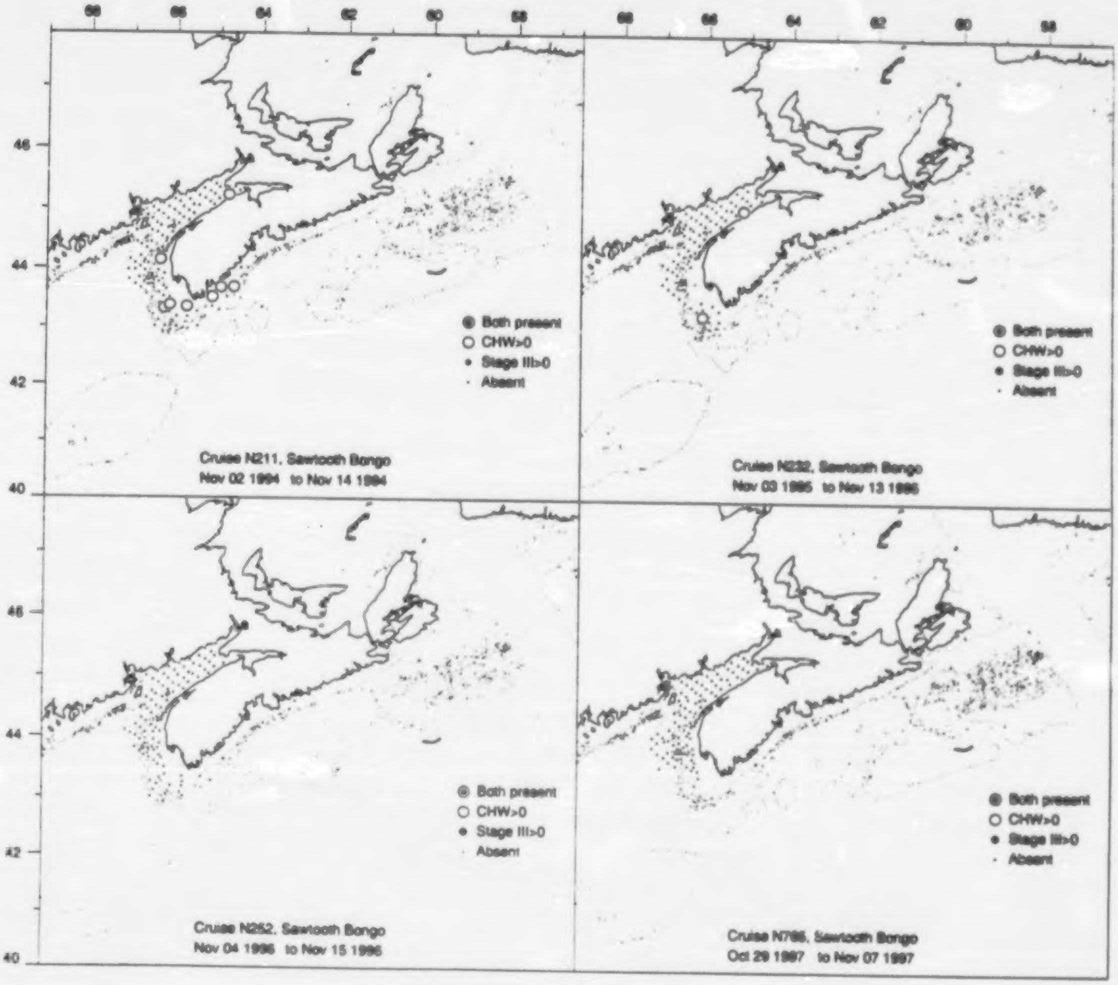

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise N211, Sawtooth Bongo
Nov 02 1994 to Nov 14 1994
Cruise N232, Sawtooth Bongo
Nov 03 1995 to Nov 13 1995
Cruise N252, Sawtooth Bongo
Nov 04 1996 to Nov 15 1996
Cruise N786, Sawtooth Bongo
Oct 29 1997 to Nov 07 1997

Fig. 8.1.2. (continued).

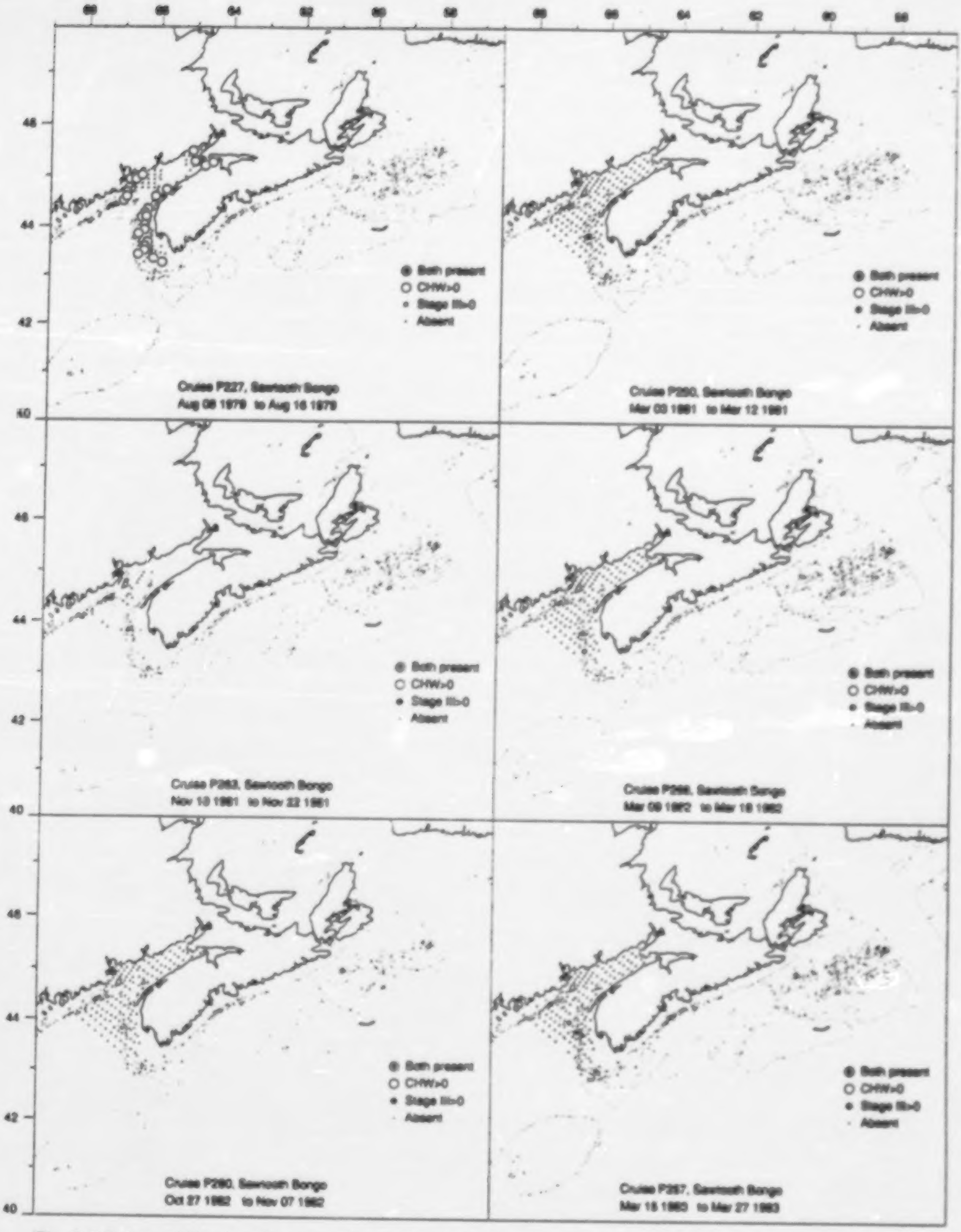

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise P227, Sawtooth Bongo
Aug 08 1979 to Aug 16 1979
Cruise P250, Sawtooth Bongo
Mar 03 1981 to Mar 12 1981
Cruise P263, Sawtooth Bongo
Nov 10 1981 to Nov 22 1981
Cruise P268, Sawtooth Bongo
Mar 09 1982 to Mar 18 1982
Cruise P280, Sawtooth Bongo
Oct 27 1982 to Nov 07 1982
Cruise P287, Sawtooth Bongo
Mar 15 1983 to Mar 27 1983

Fig. 8.1.3. Larval Herring Program-Bay of Fundy Cruises: Stage III CHW and Stage III haddock eggs.

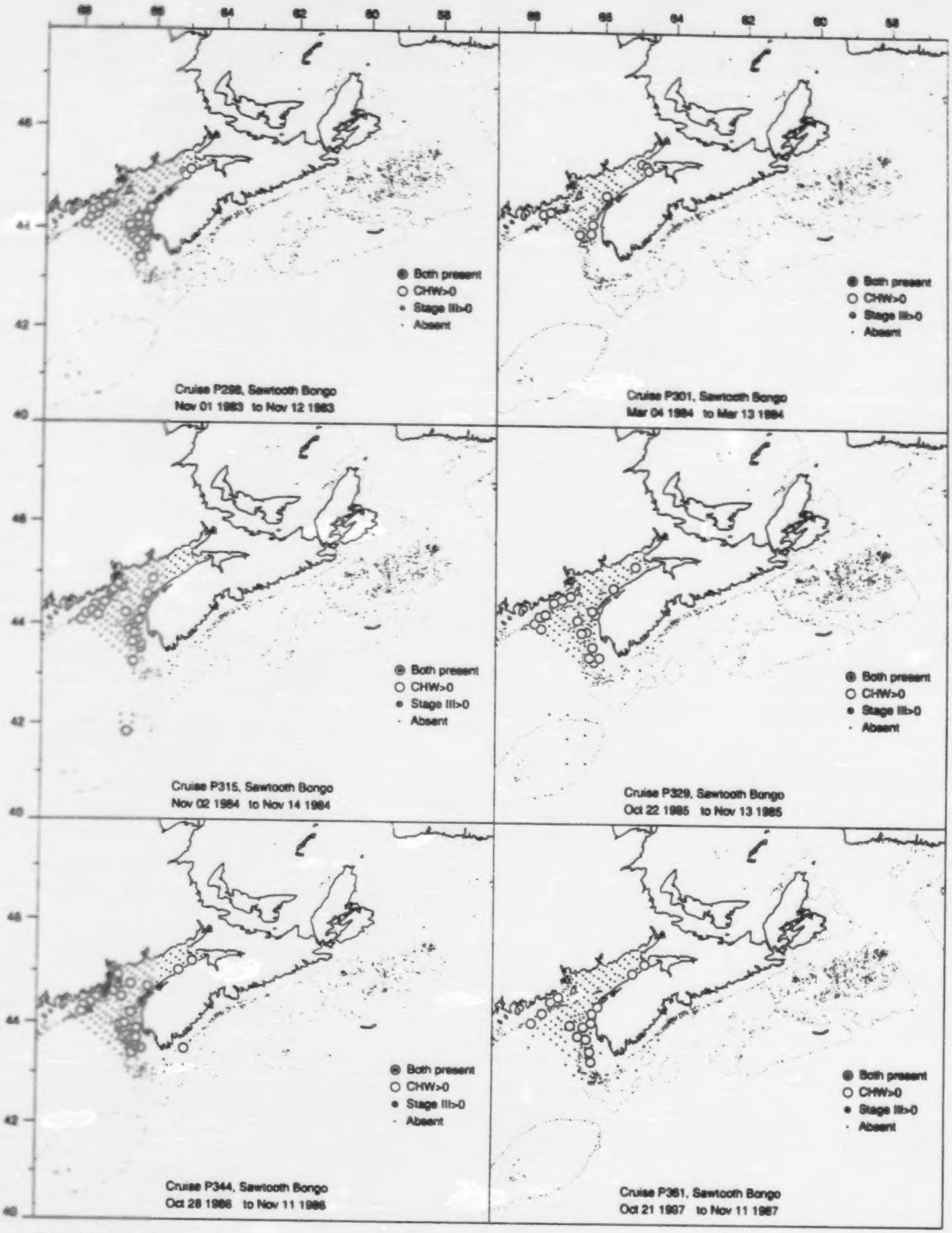

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P298, Sawtooth Bongo
Nov 01 1983 to Nov 12 1983
Cruise P301, Sawtooth Bongo
Mar 04 1984 to Mar 13 1984
Cruise P315, Sawtooth Bongo
Nov 02 1984 to Nov 14 1984
Cruise P329, Sawtooth Bongo
Oct 22 1985 to Nov 13 1985
Cruise P344, Sawtooth Bongo
Oct 28 1986 to Nov 11 1986
Cruise P361, Sawtooth Bongo
Oct 21 1987 to Nov 11 1987

Fig. 8.1.3. (continued).

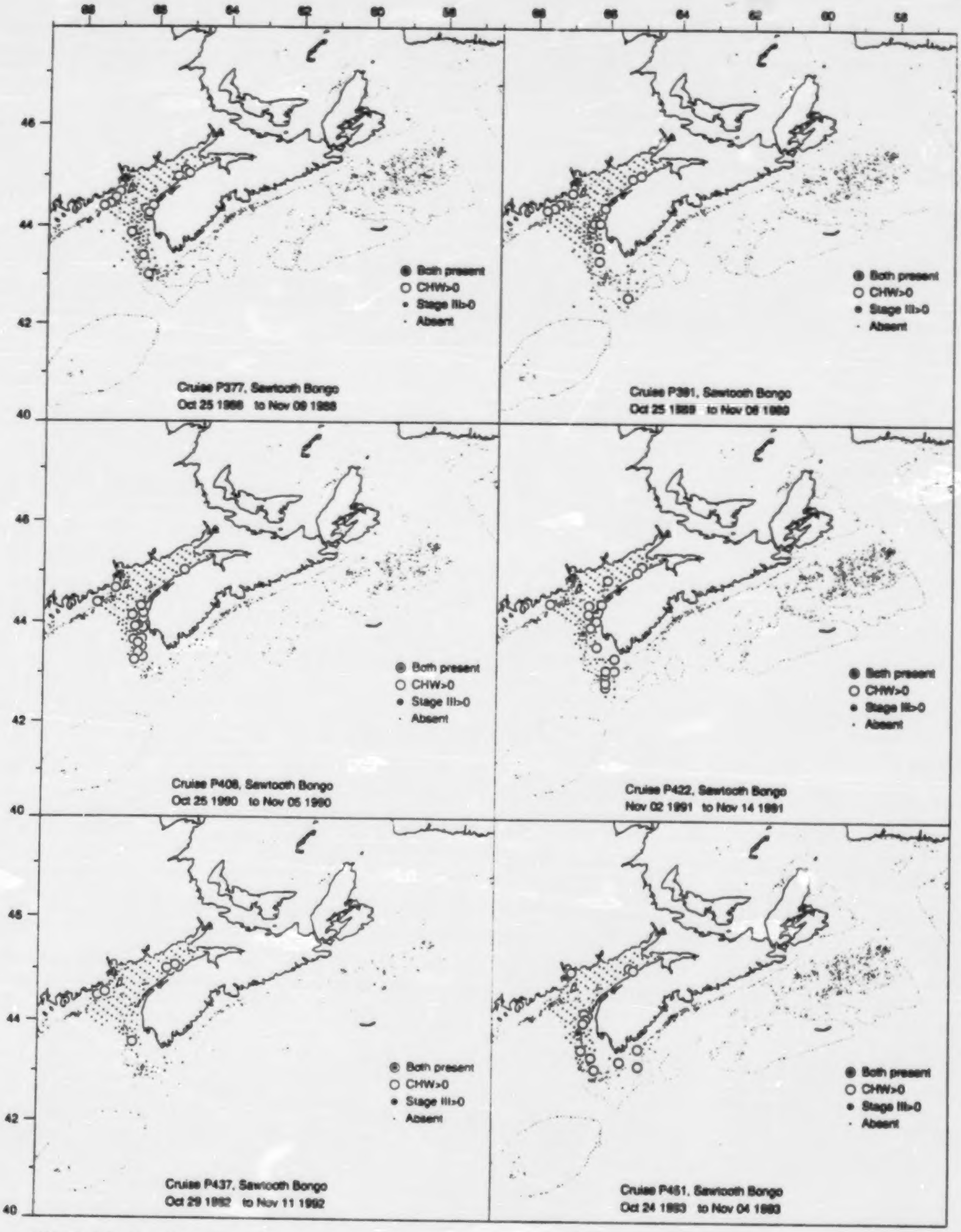

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise P377, Sawtooth Bongo
Oct 25 1988 to Nov 09 1988
Cruise P391, Sawtooth Bongo
Oct 25 1989 to Nov 08 1989
Cruise P408, Sawtooth Bongo
Oct 25 1990 to Nov 05 1990
Cruise P422, Sawtooth Bongo
Nov 02 1991 to Nov 14 1991
Cruise P437, Sawtooth Bongo
Oct 29 1992 to Nov 11 1992
Cruise P451, Sawtooth Bongo
Oct 24 1993 to Nov 04 1993

Fig. 8.1.3. (continued).

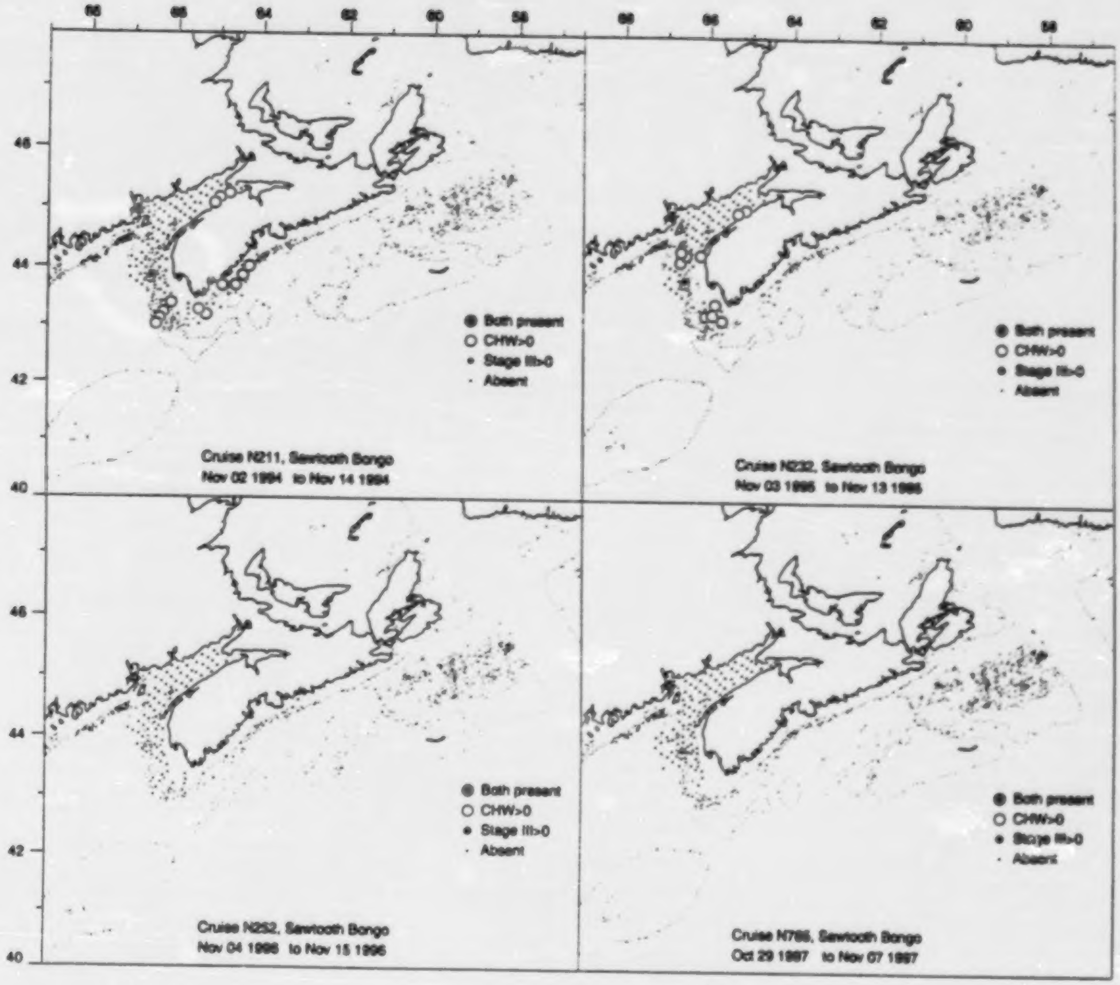

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise N211, Sawtooth Bongo
Nov 02 1994 to Nov 14 1994
Cruise N232, Sawtooth Bongo
Nov 03 1995 to Nov 13 1995
Cruise N252, Sawtooth Bongo
Nov 04 1996 to Nov 15 1996
Cruise N765, Sawtooth Bongo
Oct 29 1997 to Nov 07 1997

Fig. 8.1.3. (continued).

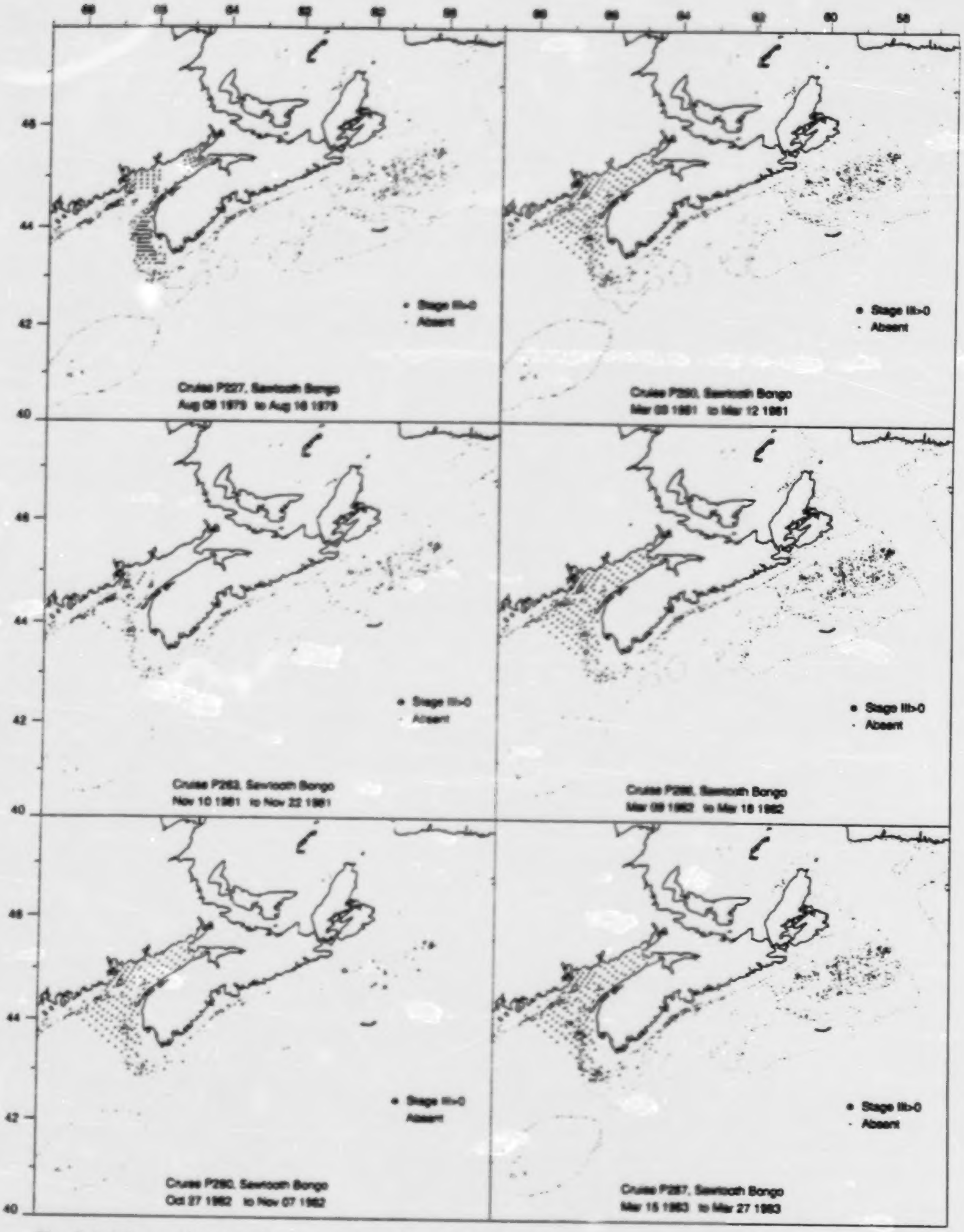

68
66
64
62
60
58
46
44
42
40
• Stage III>0
· Absent
Cruise P227, Sawtooth Bongo
Aug 08 1979 to Aug 16 1979
Cruise P250, Sawtooth Bongo
Mar 03 1981 to Mar 12 1981
Cruise P263, Sawtooth Bongo
Nov 10 1981 to Nov 22 1981
Cruise P266, Sawtooth Bongo
Mar 09 1982 to Mar 18 1982
Cruise P280, Sawtooth Bongo
Oct 27 1982 to Nov 07 1982
Cruise P287, Sawtooth Bongo
Mar 15 1983 to Mar 27 1983

Fig. 8.1.4. Larval Herring Program-Bay of Fundy Cruises: Stage III haddock eggs.

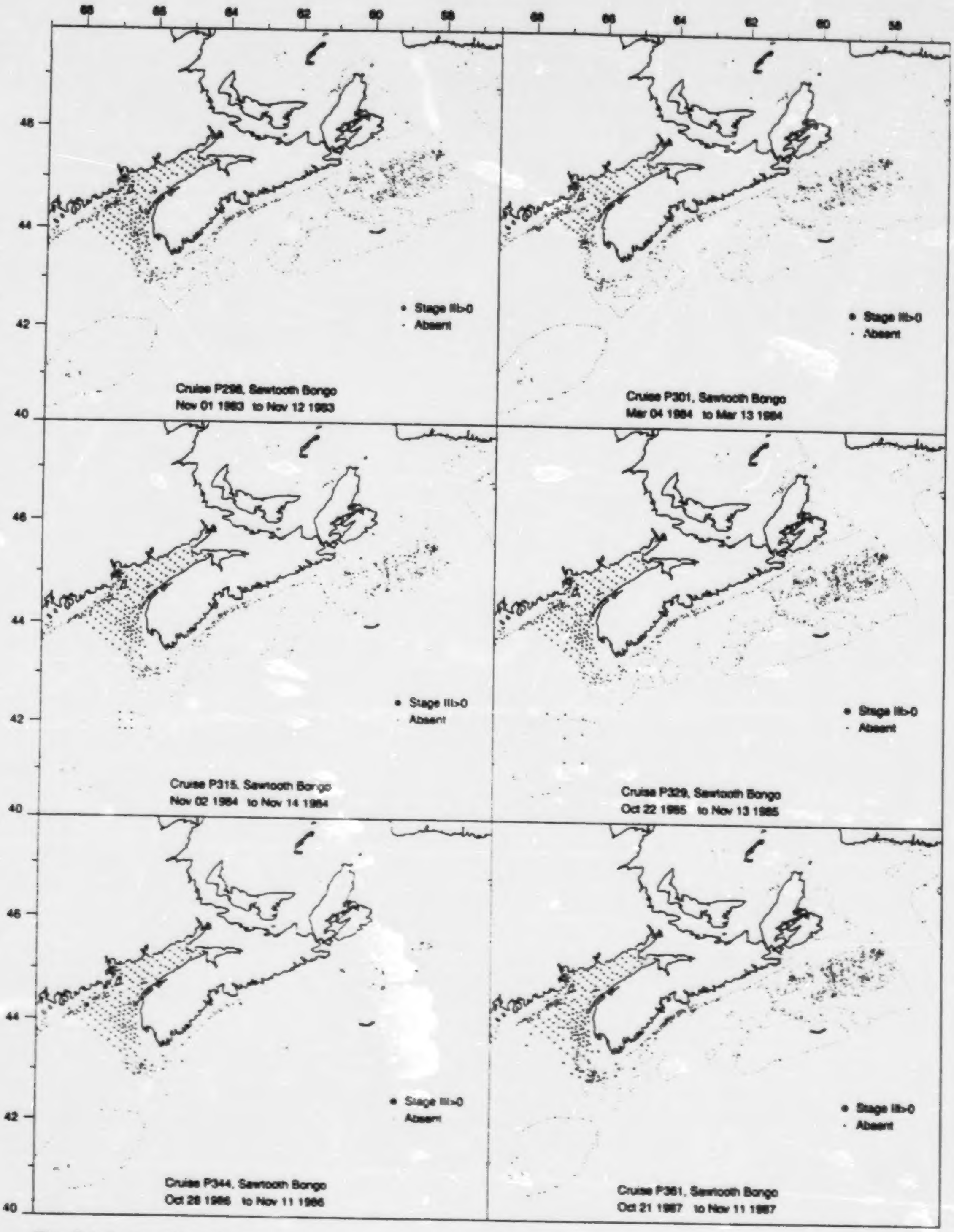

68
66
64
62
60
58
46
44
42
40
Stage III>0
Absent
Cruise P298, Sawtooth Bongo
Nov 01 1983 to Nov 12 1983
Cruise P301, Sawtooth Bongo
Mar 04 1984 to Mar 13 1984
Cruise P315, Sawtooth Bongo
Nov 02 1984 to Nov 14 1984
Cruise P329, Sawtooth Bongo
Oct 22 1985 to Nov 13 1985
Cruise P344, Sawtooth Bongo
Oct 28 1986 to Nov 11 1986
Cruise P361, Sawtooth Bongo
Oct 21 1987 to Nov 11 1987

Fig. 8.1.4. (continued).

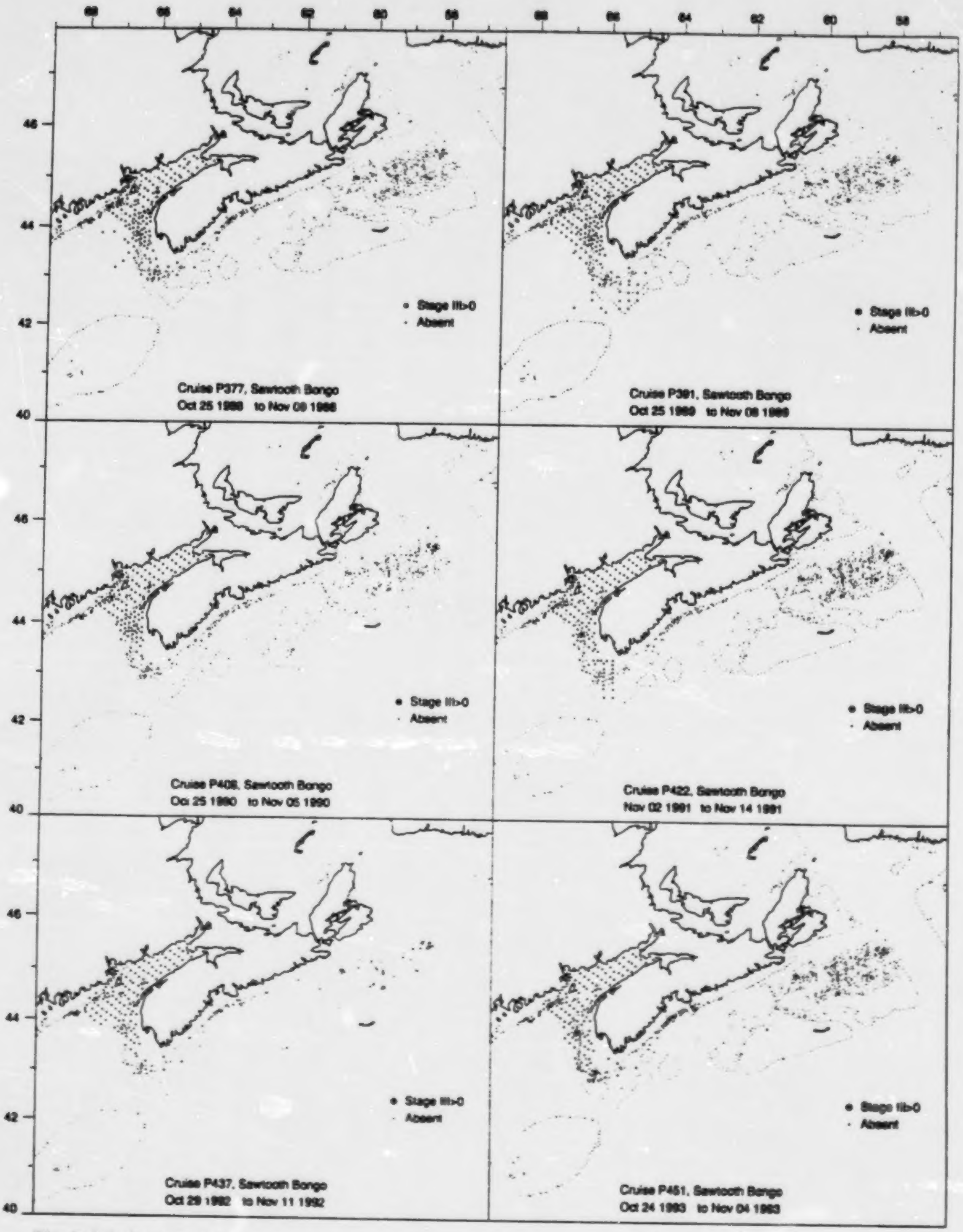
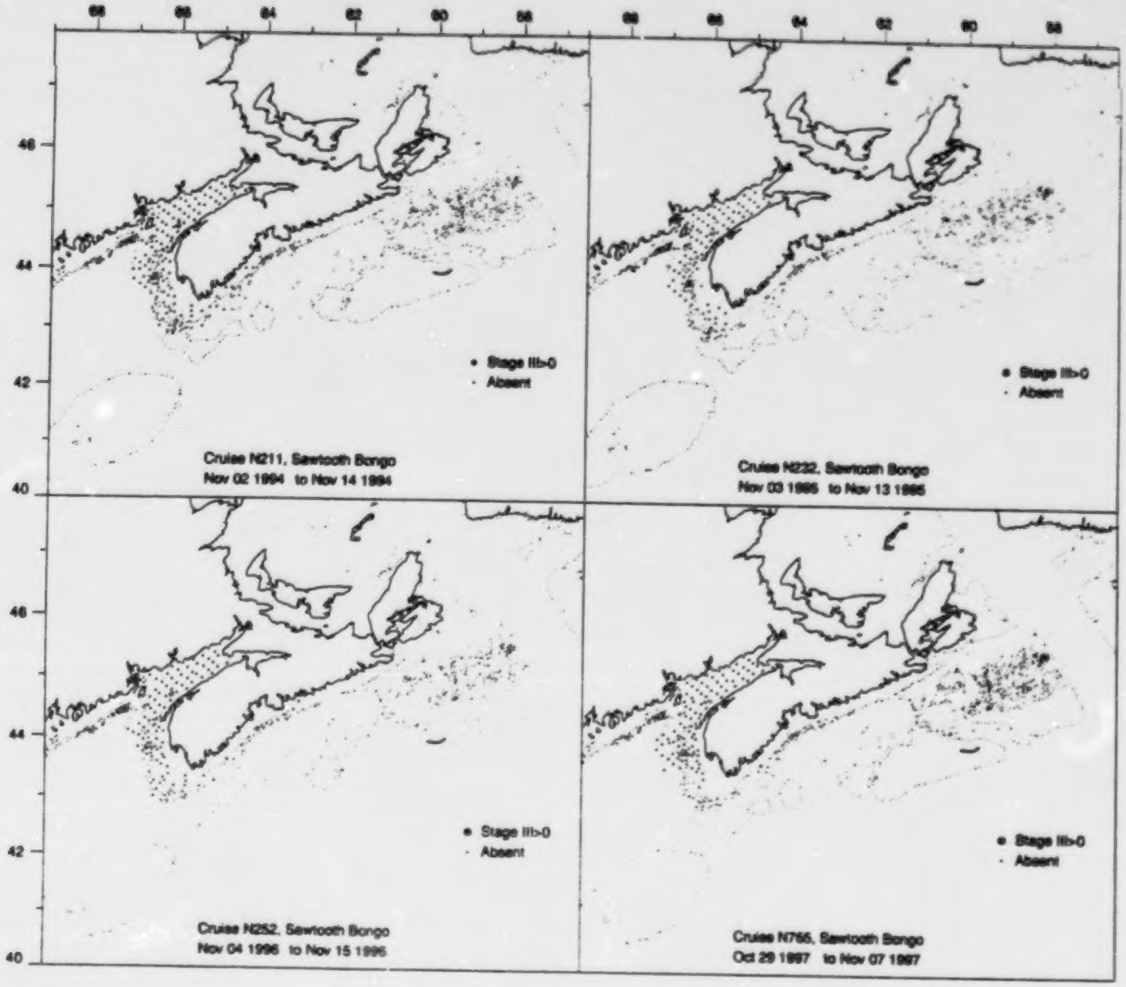

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
● Stage III>0
· Absent
Cruise P377, Sawtooth Bongo
Oct 25 1988 to Nov 08 1988
● Stage III>0
· Absent
Cruise P391, Sawtooth Bongo
Oct 25 1989 to Nov 08 1989
● Stage III>0
· Absent
Cruise P406, Sawtooth Bongo
Oct 25 1990 to Nov 05 1990
● Stage III>0
· Absent
Cruise P422, Sawtooth Bongo
Nov 02 1991 to Nov 14 1991
● Stage III>0
· Absent
Cruise P437, Sawtooth Bongo
Oct 29 1992 to Nov 11 1992
● Stage III>0
· Absent
Cruise P451, Sawtooth Bongo
Oct 24 1993 to Nov 04 1993

Fig. 8.1.4. (continued).


68
66
64
62
60
58
46
44
42
40
● Stage III>0
· Absent

Cruise N211, Sawtooth Bongo
Nov 02 1994 to Nov 14 1994

Cruise N232, Sawtooth Bongo
Nov 03 1995 to Nov 13 1995

Cruise N252, Sawtooth Bongo
Nov 04 1996 to Nov 15 1996

Cruise N765, Sawtooth Bongo
Oct 29 1997 to Nov 07 1997

Fig. 8.1.4. (continued).

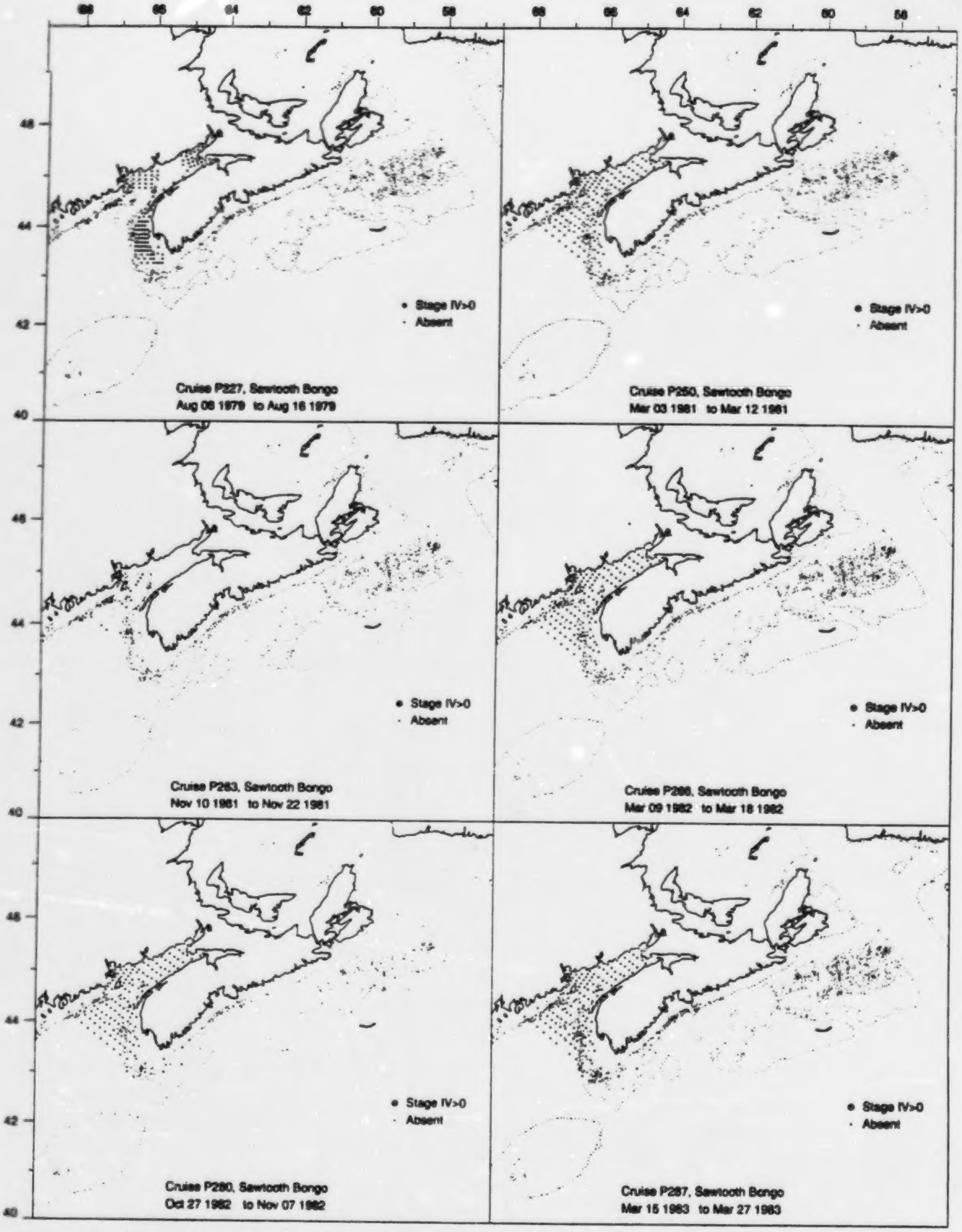

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
● Stage IV>0
· Absent
Cruise P227, Sawtooth Bongo
Aug 06 1979 to Aug 16 1979
● Stage IV>0
· Absent
Cruise P250, Sawtooth Bongo
Mar 03 1981 to Mar 12 1981
46
44
42
40
● Stage IV>0
· Absent
Cruise P263, Sawtooth Bongo
Nov 10 1981 to Nov 22 1981
● Stage IV>0
· Absent
Cruise P266, Sawtooth Bongo
Mar 09 1982 to Mar 18 1982
46
44
42
40
● Stage IV>0
· Absent
Cruise P280, Sawtooth Bongo
Oct 27 1982 to Nov 07 1982
● Stage IV>0
· Absent
Cruise P287, Sawtooth Bongo
Mar 15 1983 to Mar 27 1983

Fig. 8.1.5. Larval Herring Program-Bay of Fundy Cruises: Stage IV haddock eggs.

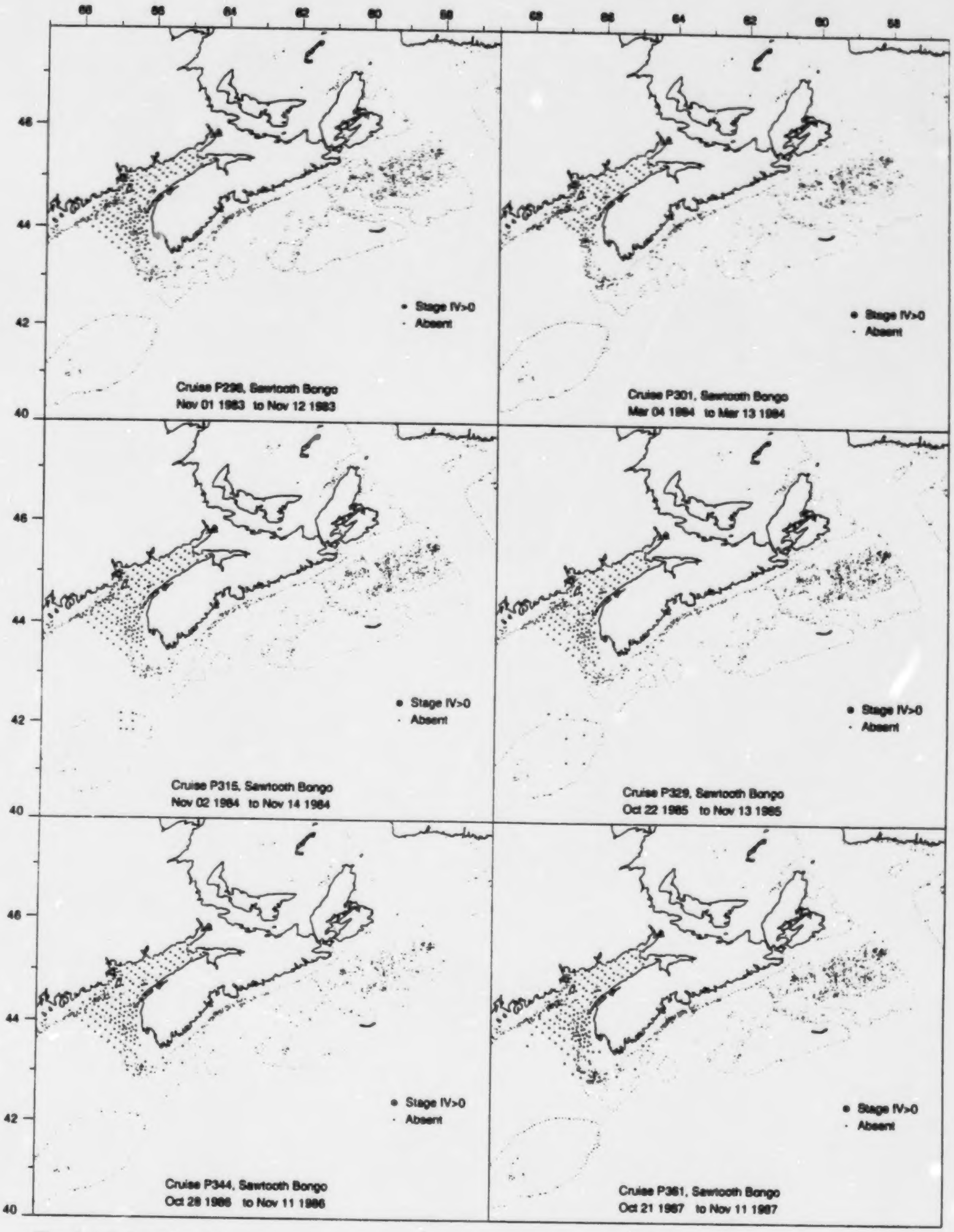

68
66
64
62
60
58
46
44
42
40
• Stage IV>0
· Absent
Cruise P298, Sawtooth Bongo
Nov 01 1983 to Nov 12 1983
Cruise P301, Sawtooth Bongo
Mar 04 1984 to Mar 13 1984
Cruise P315, Sawtooth Bongo
Nov 02 1984 to Nov 14 1984
Cruise P329, Sawtooth Bongo
Oct 22 1985 to Nov 13 1985
Cruise P344, Sawtooth Bongo
Oct 28 1986 to Nov 11 1986
Cruise P361, Sawtooth Bongo
Oct 21 1987 to Nov 11 1987

Fig. 8.1.5. (continued).

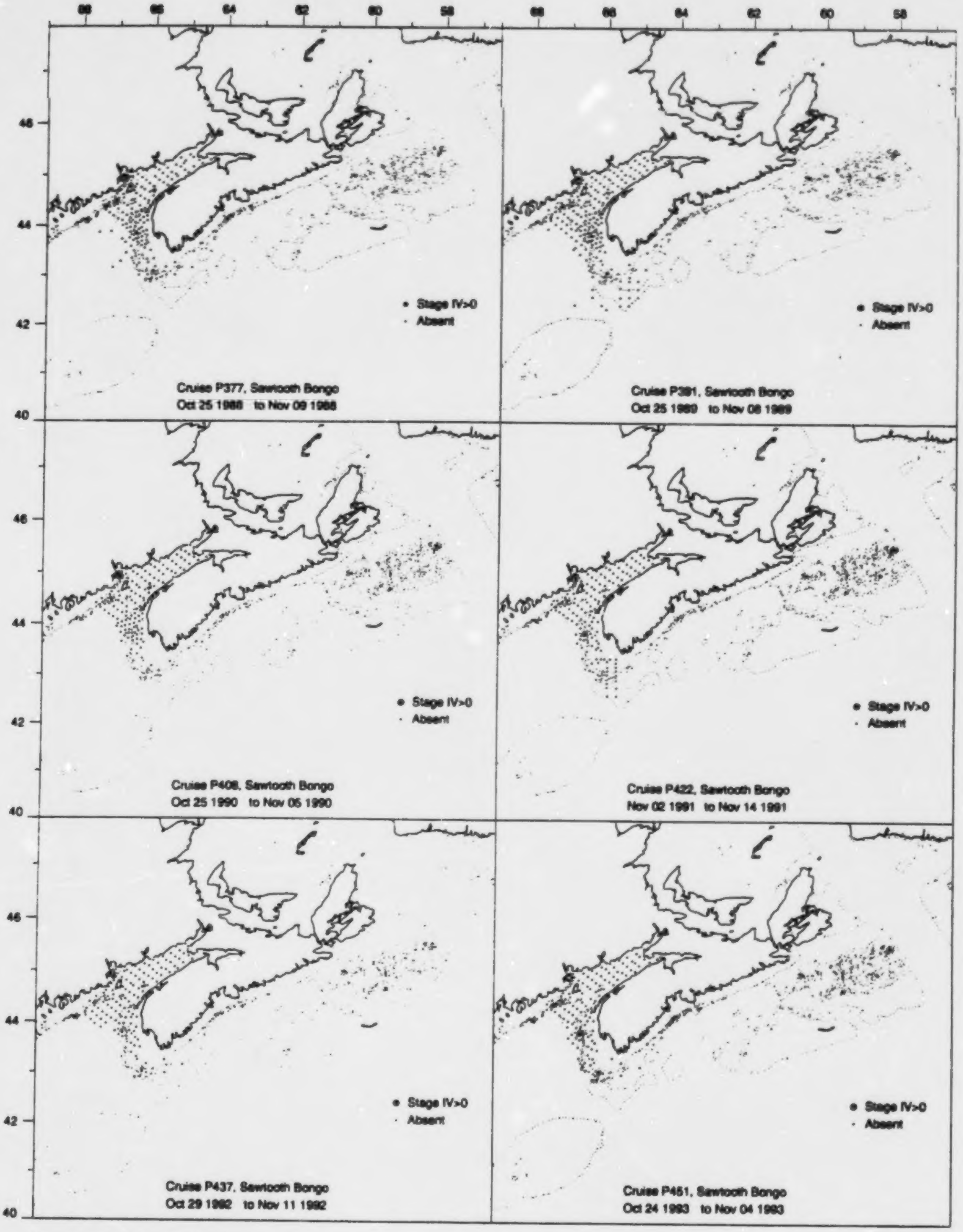

68
66
64
62
60
58
46
44
42
40
● Stage IV>0
· Absent
Cruise P377, Sawtooth Bongo
Oct 25 1988 to Nov 09 1988
Cruise P391, Sawtooth Bongo
Oct 25 1989 to Nov 08 1989
Cruise P408, Sawtooth Bongo
Oct 25 1990 to Nov 05 1990
Cruise P422, Sawtooth Bongo
Nov 02 1991 to Nov 14 1991
Cruise P437, Sawtooth Bongo
Oct 29 1992 to Nov 11 1992
Cruise P451, Sawtooth Bongo
Oct 24 1993 to Nov 04 1993

Fig. 8.1.5. (continued).

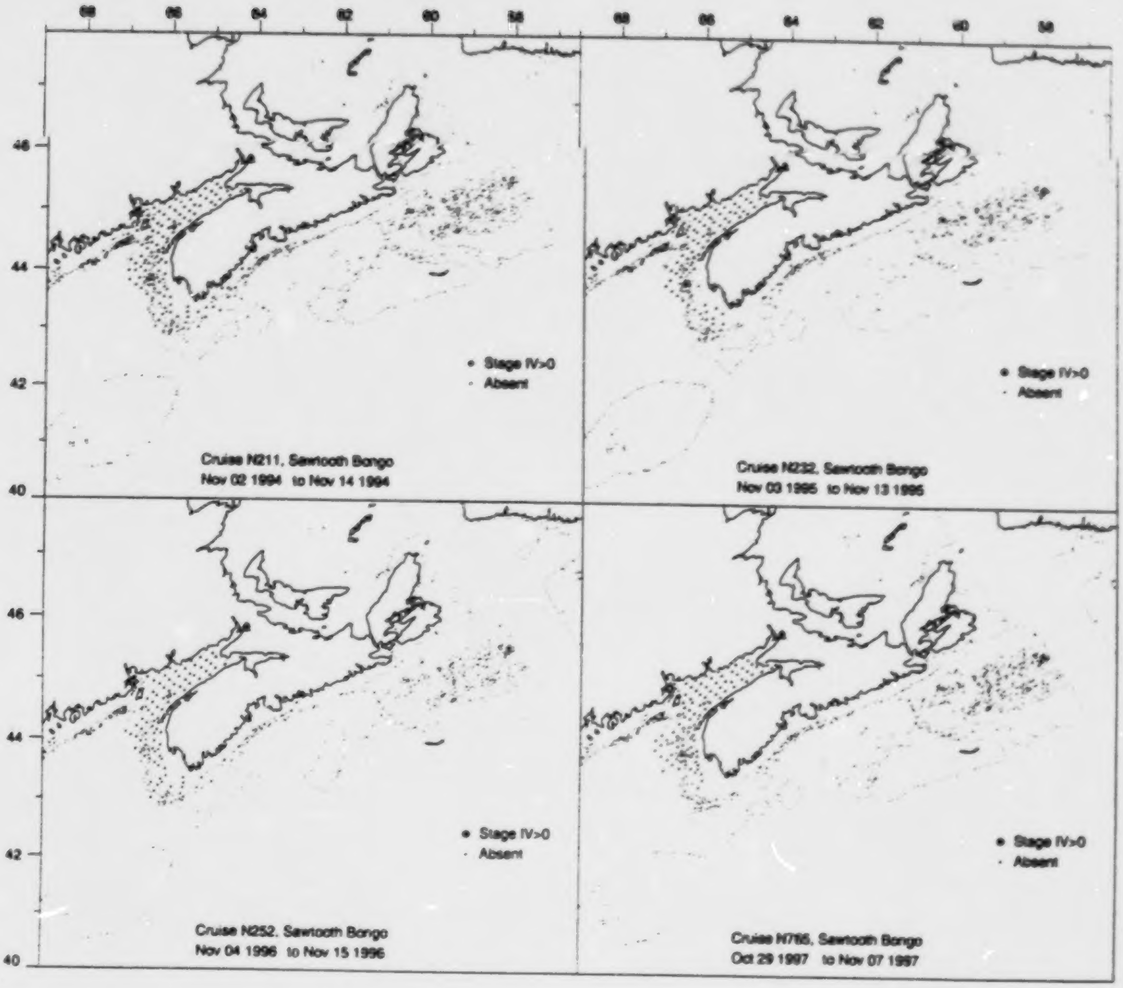
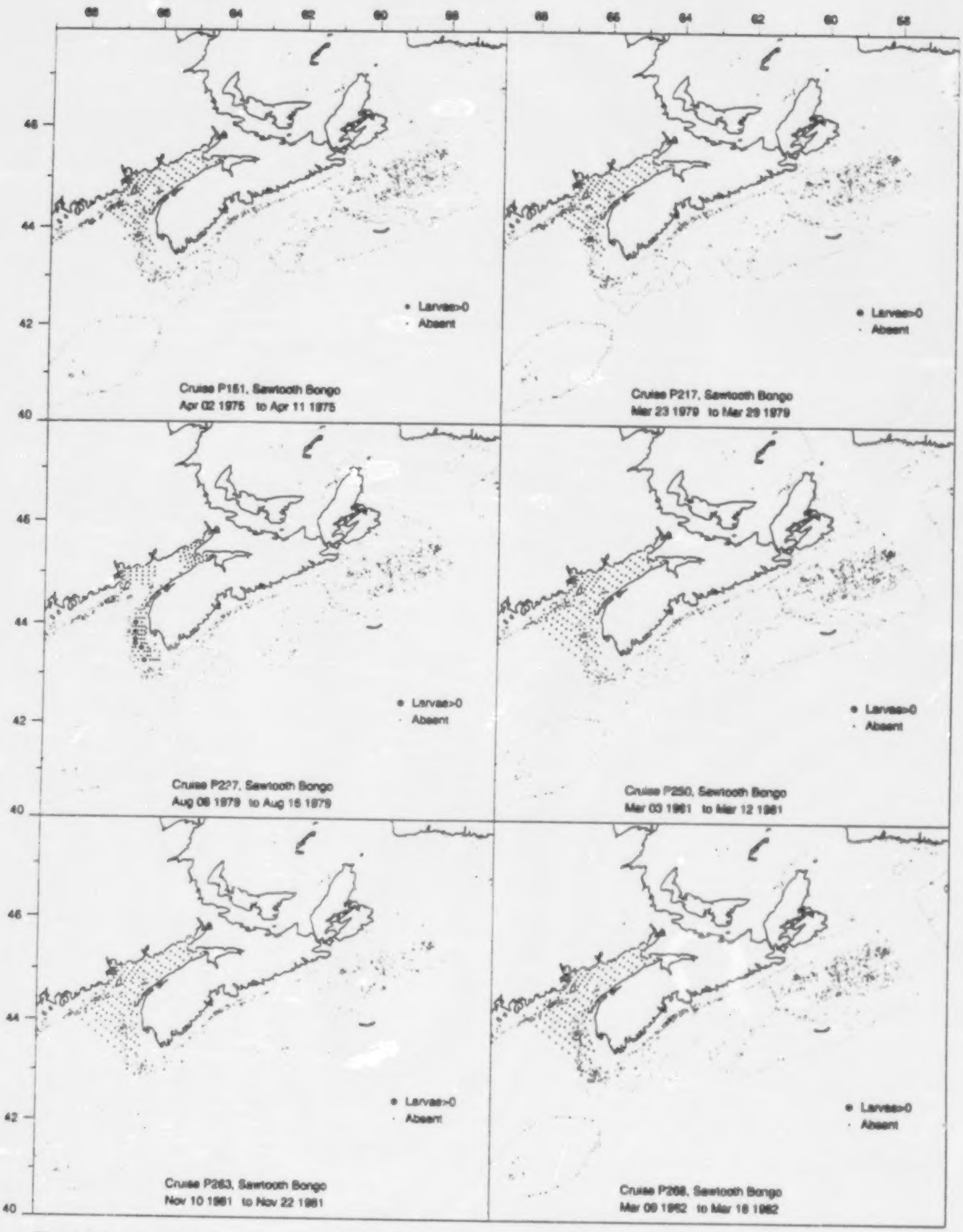

68
66
64
62
60
58
46
44
42
40
• Stage IV>0
· Absent
Cruise N211, Sawtooth Bongo
Nov 02 1994 to Nov 14 1994
Cruise N232, Sawtooth Bongo
Nov 03 1995 to Nov 13 1995
Cruise N252, Sawtooth Bongo
Nov 04 1996 to Nov 15 1996
Cruise N765, Sawtooth Bongo
Oct 29 1997 to Nov 07 1997

Fig. 8.1.5. (continued).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66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
● Larvae>0
· Absent
Cruise P151, Sawtooth Bongo
Apr 02 1975 to Apr 11 1975
● Larvae>0
· Absent
Cruise P217, Sawtooth Bongo
Mar 23 1979 to Mar 29 1979
● Larvae>0
· Absent
Cruise P227, Sawtooth Bongo
Aug 08 1979 to Aug 16 1979
● Larvae>0
· Absent
Cruise P250, Sawtooth Bongo
Mar 03 1981 to Mar 12 1981
● Larvae>0
· Absent
Cruise P263, Sawtooth Bongo
Nov 10 1981 to Nov 22 1981
● Larvae>0
· Absent
Cruise P268, Sawtooth Bongo
Mar 09 1982 to Mar 16 1982

Fig. 8.1.6. Larval Herring Program-Bay of Fundy Cruises: Haddock larvae (1-7mm).

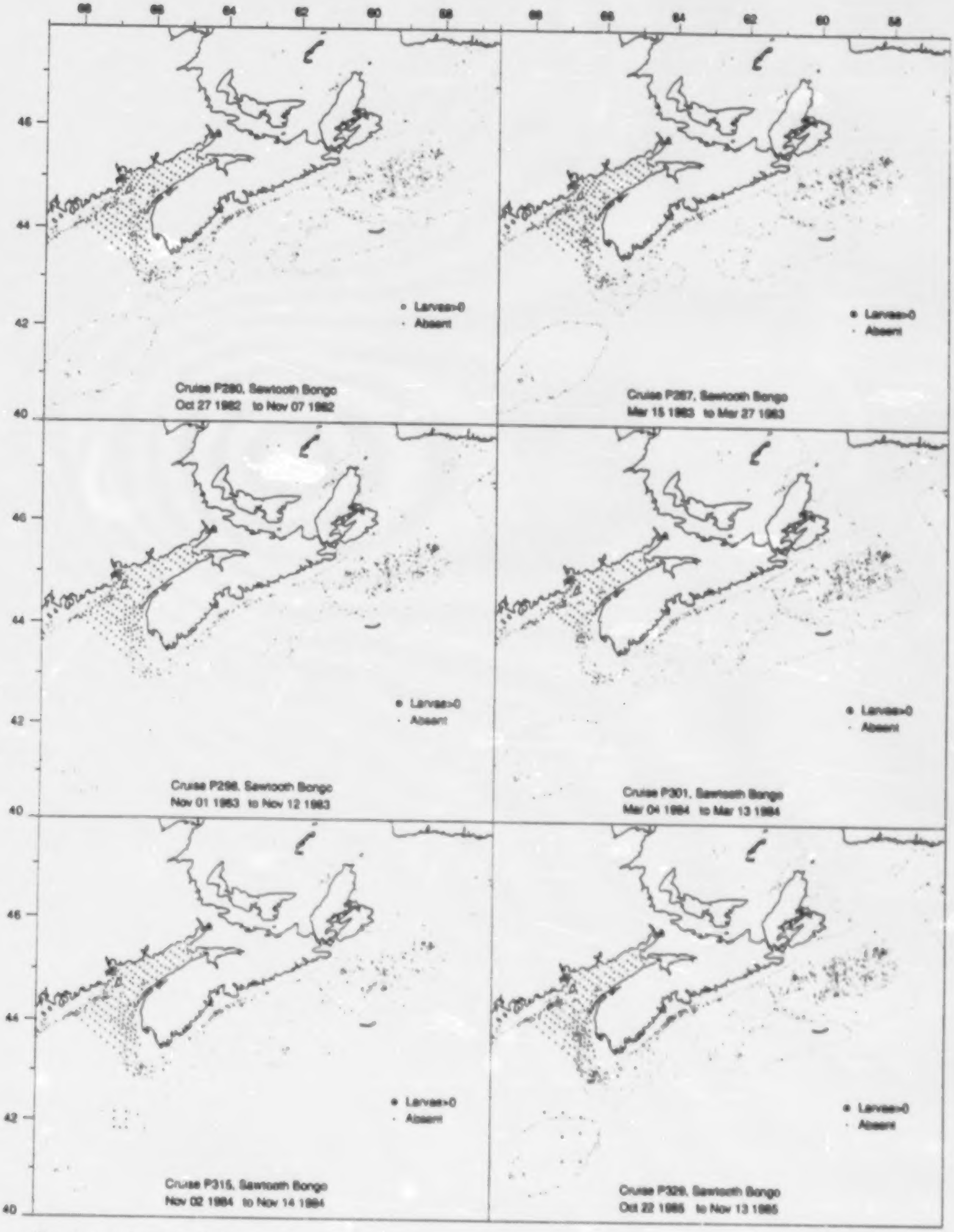

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
Larvae>0
Absent
Cruise P280, Sawtooth Bongo
Oct 27 1982 to Nov 07 1982
Larvae>0
Absent
Cruise P287, Sawtooth Bongo
Mar 15 1983 to Mar 27 1983
Larvae>0
Absent
Cruise P296, Sawtooth Bongo
Nov 01 1983 to Nov 12 1983
Larvae>0
Absent
Cruise P301, Sawtooth Bongo
Mar 04 1984 to Mar 13 1984
Larvae>0
Absent
Cruise P315, Sawtooth Bongo
Nov 02 1984 to Nov 14 1984
Larvae>0
Absent
Cruise P329, Sawtooth Bongo
Oct 22 1985 to Nov 13 1985

Fig. 8.1.6. (continued).

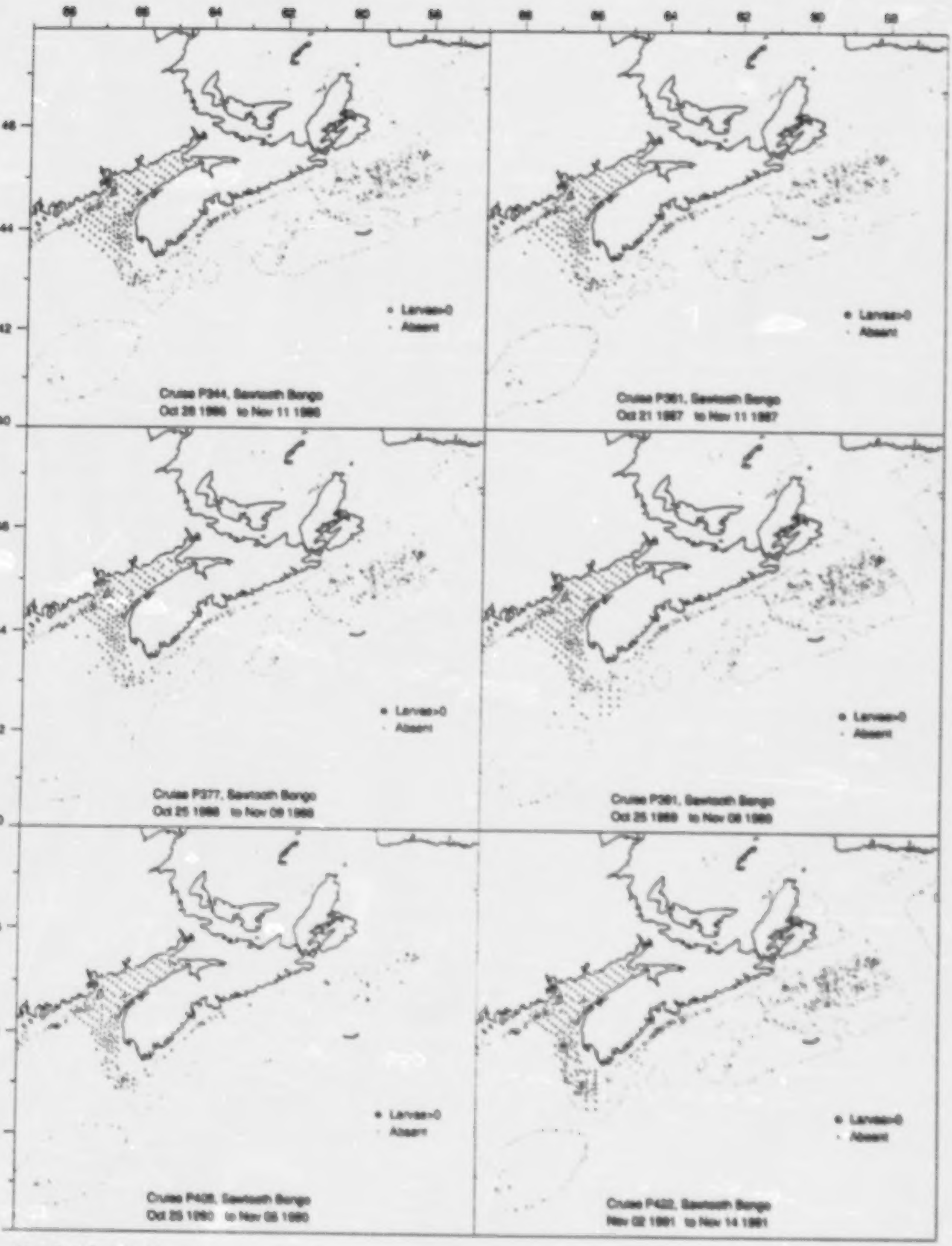

68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent
Cruise P344, Sawtooth Bongo
Oct 28 1986 to Nov 11 1986
Cruise P361, Sawtooth Bongo
Oct 21 1987 to Nov 11 1987
Cruise P377, Sawtooth Bongo
Oct 25 1988 to Nov 09 1988
Cruise P391, Sawtooth Bongo
Oct 25 1989 to Nov 08 1989
Cruise P408, Sawtooth Bongo
Oct 25 1990 to Nov 08 1990
Cruise P422, Sawtooth Bongo
Nov 02 1991 to Nov 14 1991

Fig. 8.1.6. (continued).

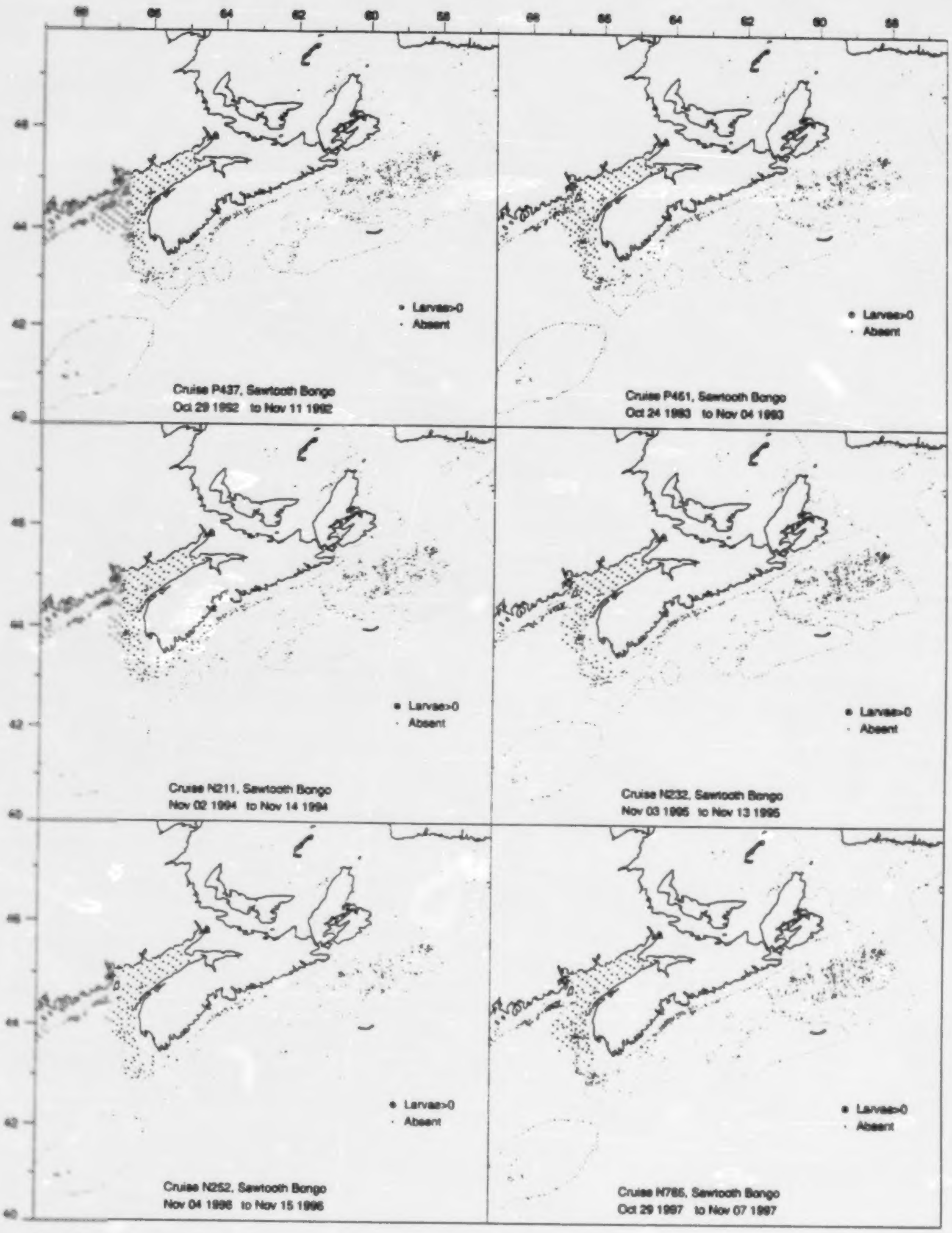

68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent
Cruise P437, Sawtooth Bongo
Oct 29 1992 to Nov 11 1992
Cruise P451, Sawtooth Bongo
Oct 24 1993 to Nov 04 1993
Cruise N211, Sawtooth Bongo
Nov 02 1994 to Nov 14 1994
Cruise N232, Sawtooth Bongo
Nov 03 1995 to Nov 13 1995
Cruise N252, Sawtooth Bongo
Nov 04 1996 to Nov 15 1996
Cruise N785, Sawtooth Bongo
Oct 29 1997 to Nov 07 1997

Fig. 8.1.6. (continued).

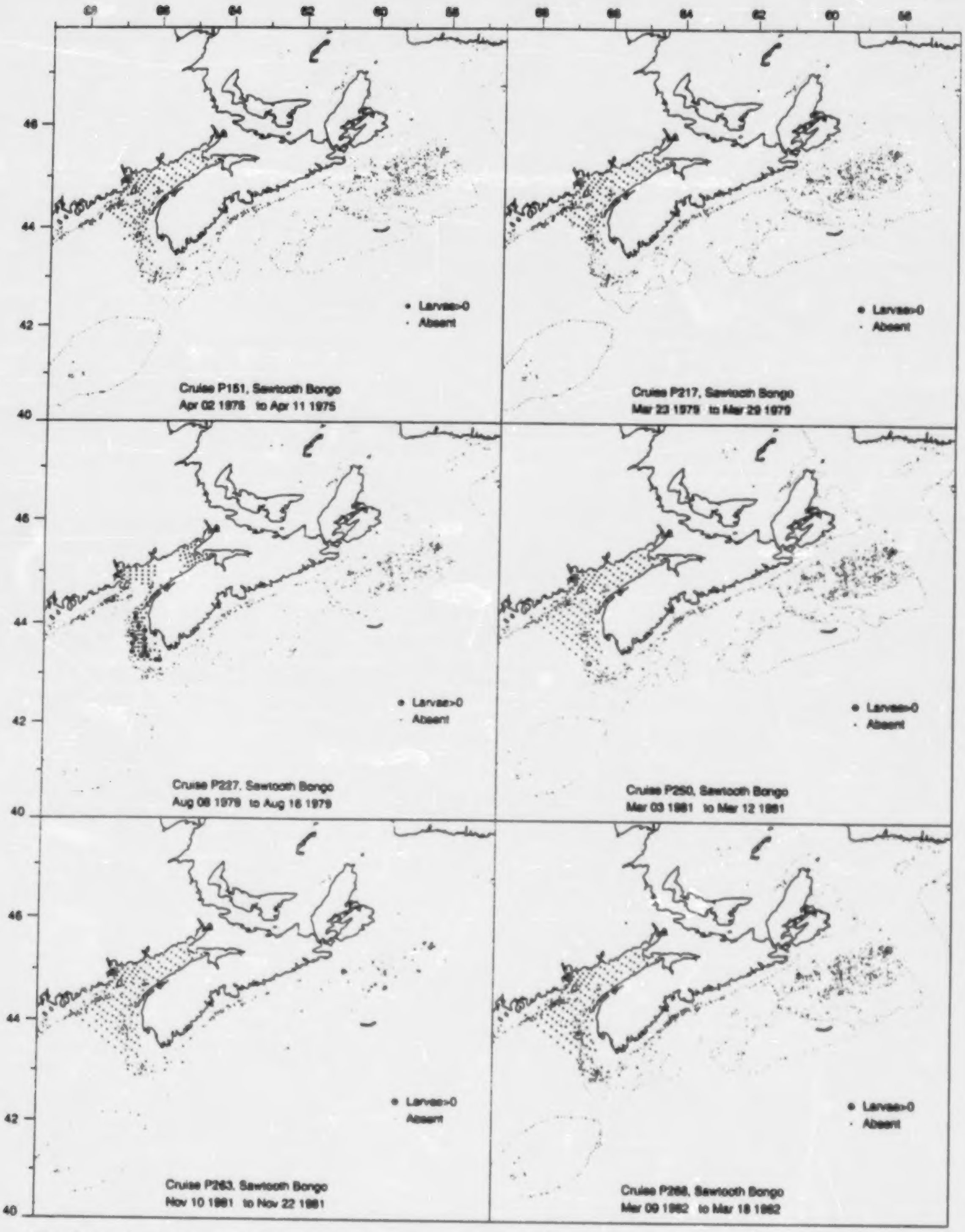

68
66
64
62
60
58
46
44
42
40
• Larvae>0
· Absent
Cruise P151, Sawtooth Bongo
Apr 02 1975 to Apr 11 1975
Cruise P217, Sawtooth Bongo
Mar 23 1979 to Mar 29 1979
Cruise P227, Sawtooth Bongo
Aug 08 1979 to Aug 16 1979
Cruise P250, Sawtooth Bongo
Mar 03 1981 to Mar 12 1981
Cruise P263, Sawtooth Bongo
Nov 10 1981 to Nov 22 1981
Cruise P268, Sawtooth Bongo
Mar 09 1982 to Mar 18 1982

Fig. 8.1.7. Larval Herring Program-Bay of Fundy Cruises: Haddock larvae (7+mm).

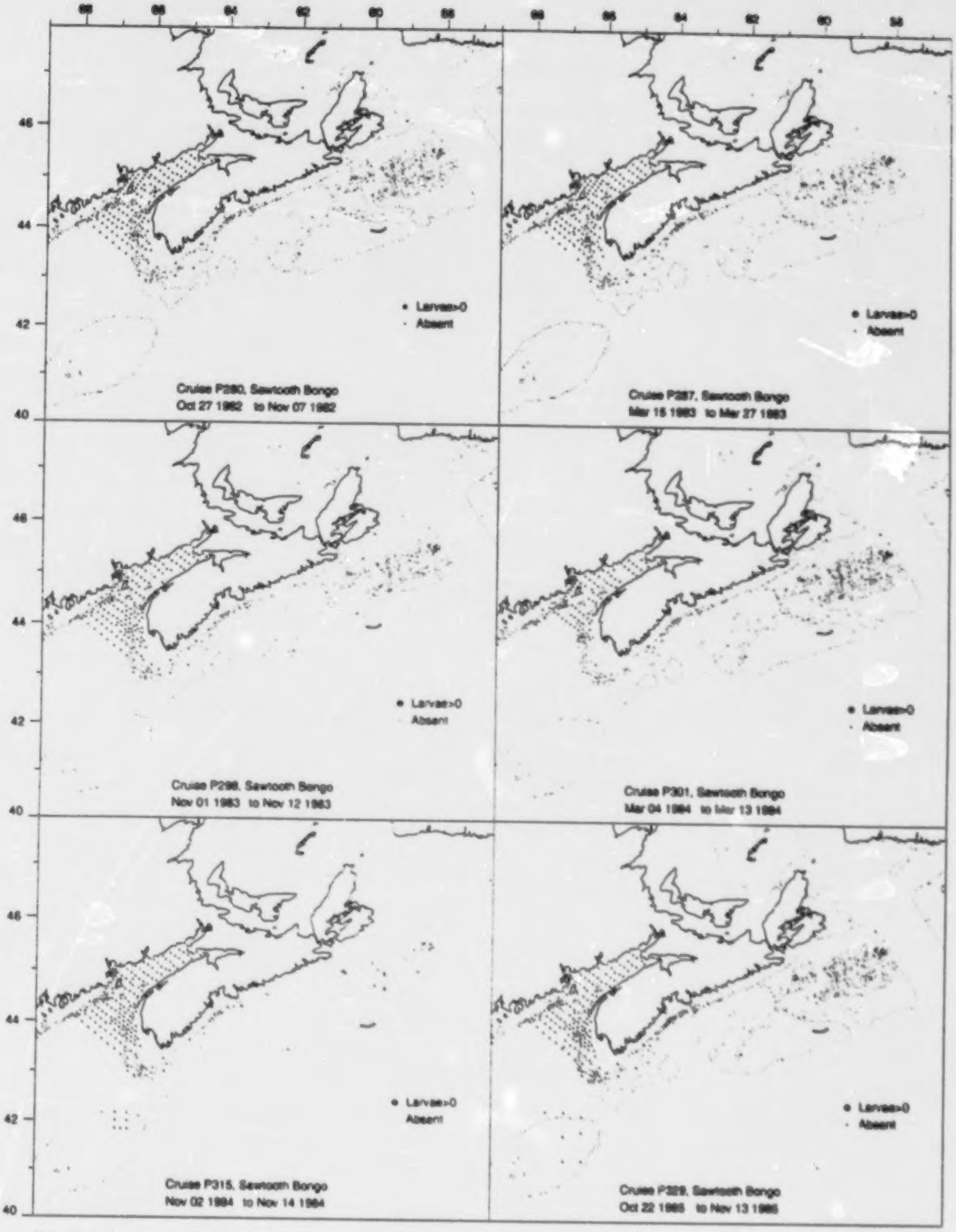

68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent
Cruise P280, Sawtooth Bongo
Oct 27 1982 to Nov 07 1982
Cruise P287, Sawtooth Bongo
Mar 15 1983 to Mar 27 1983
Cruise P298, Sawtooth Bongo
Nov 01 1983 to Nov 12 1983
Cruise P301, Sawtooth Bongo
Mar 04 1984 to Mar 13 1984
Cruise P315, Sawtooth Bongo
Nov 02 1984 to Nov 14 1984
Cruise P329, Sawtooth Bongo
Oct 22 1985 to Nov 13 1985

Fig. 8.1.7. (continued).

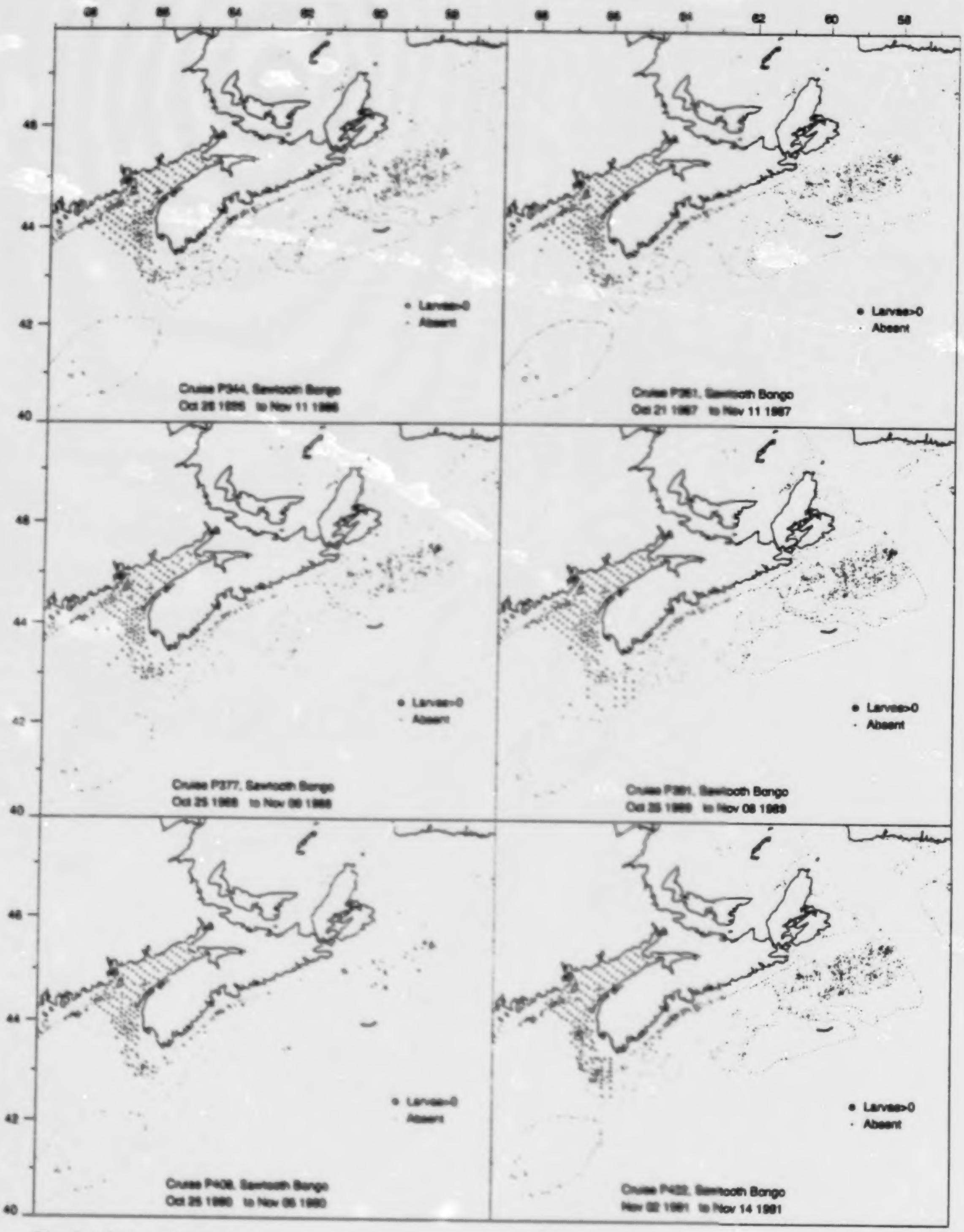
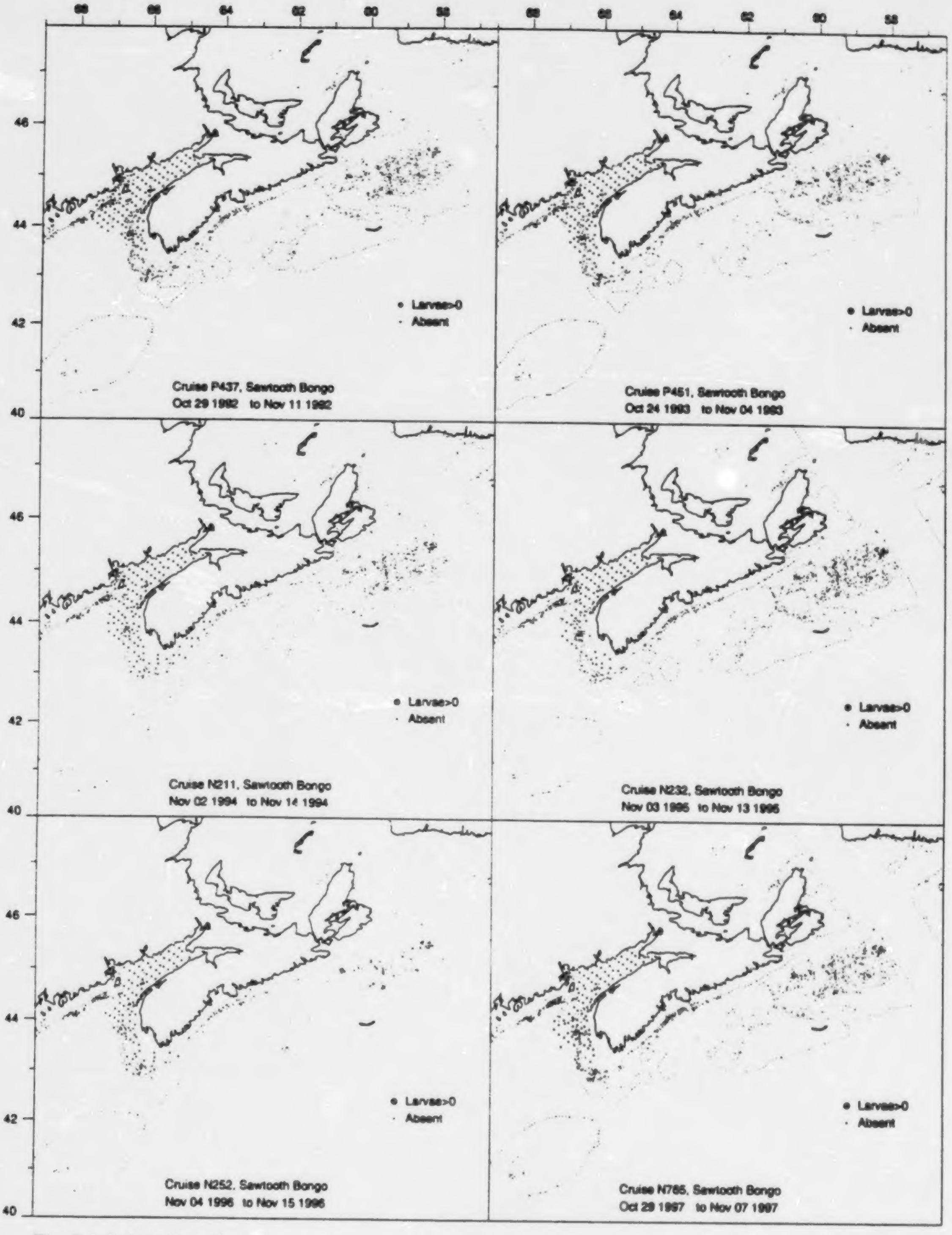

68
66
64
62
60
58
46
44
42
40
● Larvae>0
· Absent
Cruise P344, Sawtooth Bongo
Oct 25 1986 to Nov 11 1986
Cruise P361, Sawtooth Bongo
Oct 21 1987 to Nov 11 1987
Cruise P377, Sawtooth Bongo
Oct 25 1988 to Nov 08 1988
Cruise P391, Sawtooth Bongo
Oct 25 1989 to Nov 08 1989
Cruise P408, Sawtooth Bongo
Oct 25 1990 to Nov 05 1990
Cruise P422, Sawtooth Bongo
Nov 02 1991 to Nov 14 1991

Fig. 8.1.7. (continued).


68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent

Cruise P437, Sawtooth Bongo
Oct 29 1992 to Nov 11 1992

Cruise P451, Sawtooth Bongo
Oct 24 1993 to Nov 04 1993

Cruise N211, Sawtooth Bongo
Nov 02 1994 to Nov 14 1994

Cruise N232, Sawtooth Bongo
Nov 03 1995 to Nov 13 1995

Cruise N252, Sawtooth Bongo
Nov 04 1996 to Nov 15 1996

Cruise N765, Sawtooth Bongo
Oct 29 1997 to Nov 07 1997

Fig. 8.1.7. (continued).

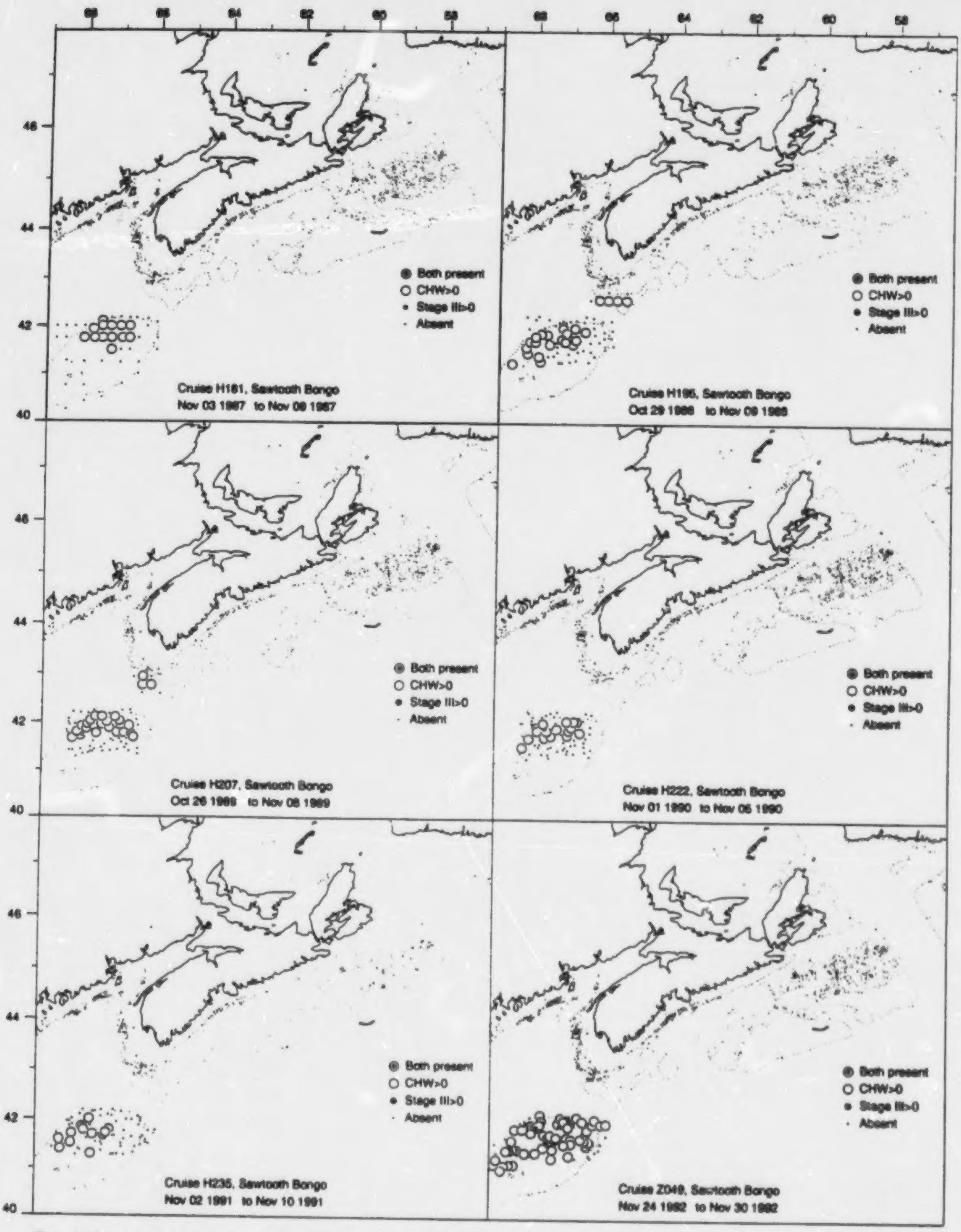

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise H181, Sawtooth Bongo
Nov 03 1987 to Nov 09 1987
Cruise H196, Sawtooth Bongo
Oct 29 1988 to Nov 09 1988
Cruise H207, Sawtooth Bongo
Oct 26 1989 to Nov 08 1989
Cruise H222, Sawtooth Bongo
Nov 01 1990 to Nov 06 1990
Cruise H235, Sawtooth Bongo
Nov 02 1991 to Nov 10 1991
Cruise Z049, Sawtooth Bongo
Nov 24 1992 to Nov 30 1992

Fig. 8.2.1. Larval Herring Program-Georges Bank Cruises: Stage I CHW and Stage III haddock eggs.

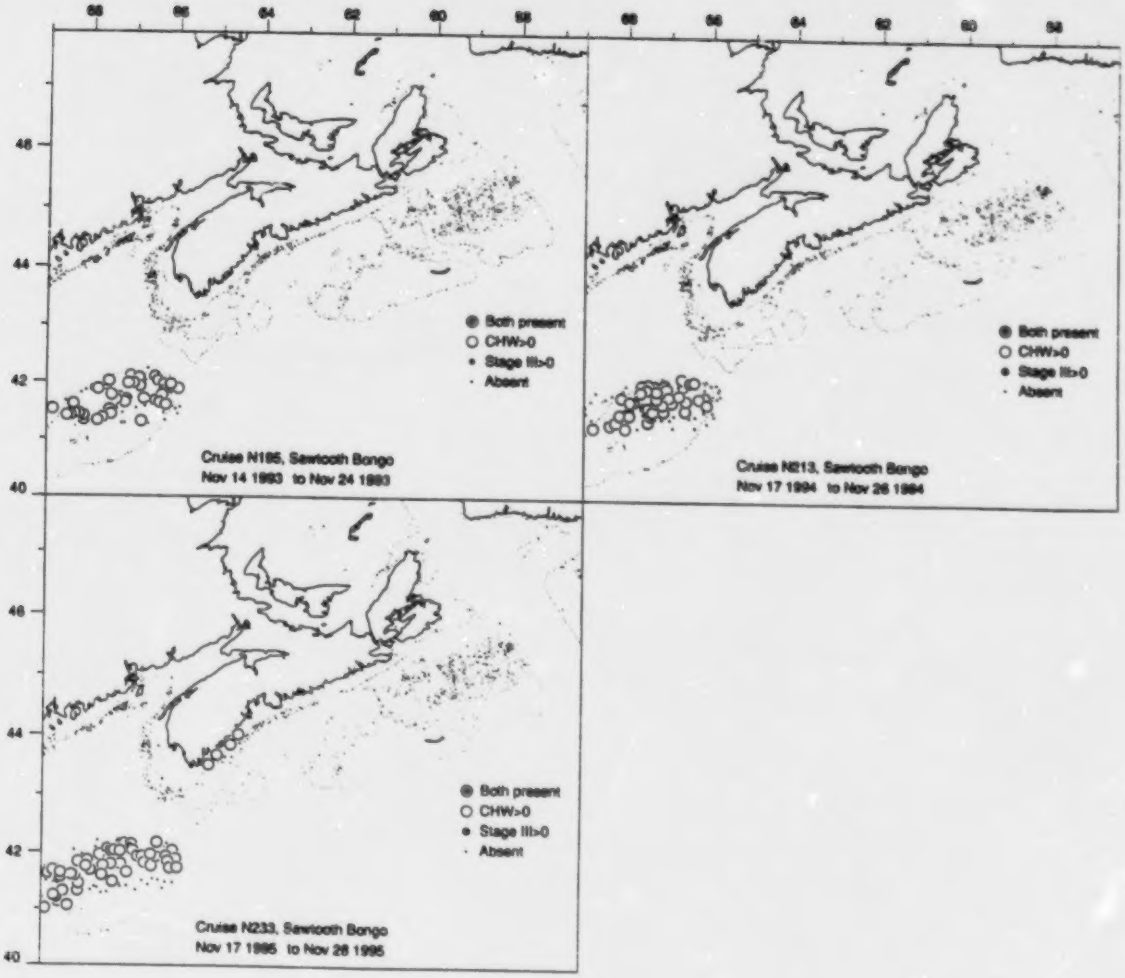

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise N185, Sawtooth Bongo
Nov 14 1993 to Nov 24 1993
Cruise N213, Sawtooth Bongo
Nov 17 1994 to Nov 26 1994
Cruise N233, Sawtooth Bongo
Nov 17 1995 to Nov 28 1995

Fig. 8.2.1. (continued).

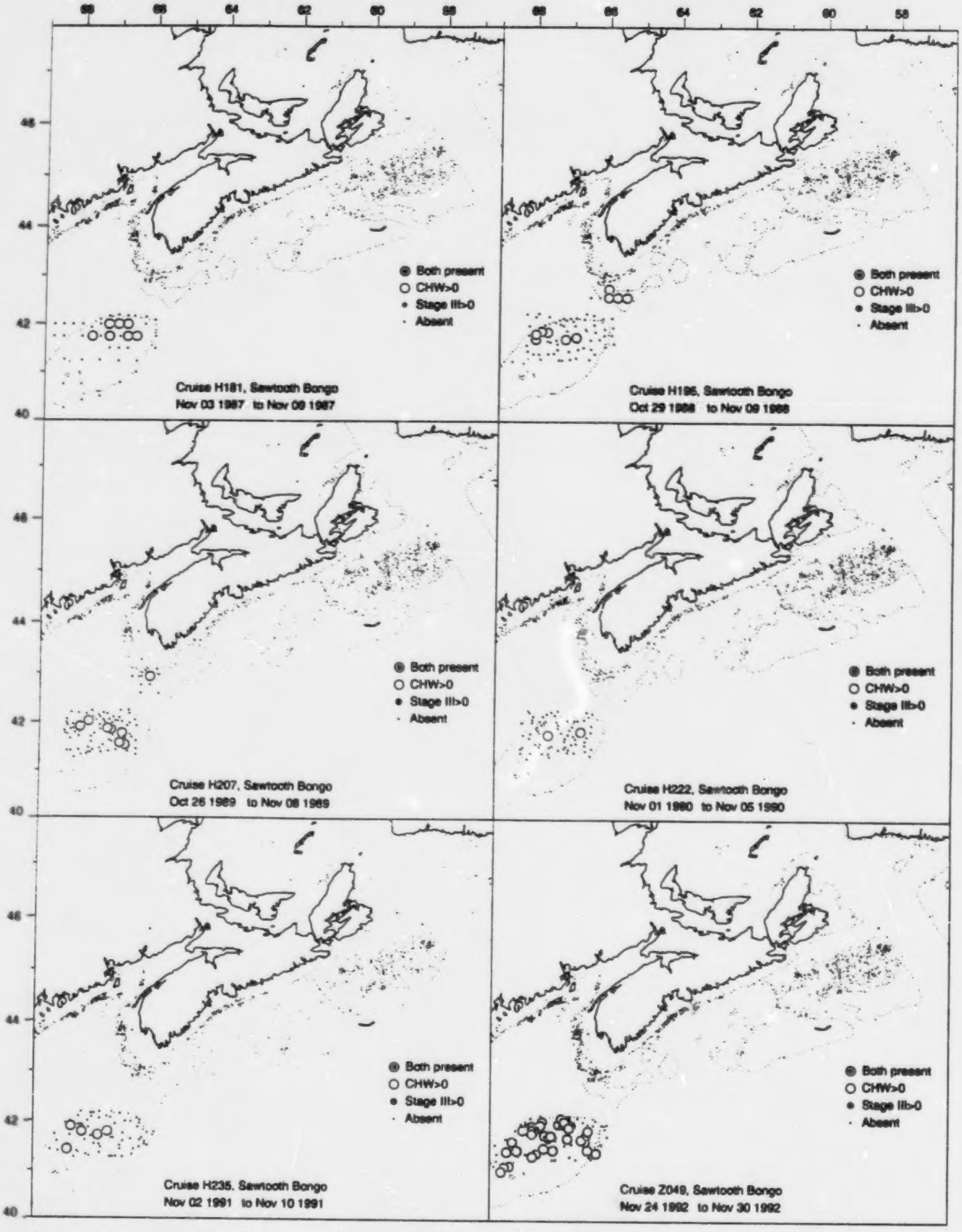

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H181, Sawtooth Bongo
Nov 03 1987 to Nov 09 1987
Cruise H196, Sawtooth Bongo
Oct 29 1988 to Nov 09 1988
Cruise H207, Sawtooth Bongo
Oct 26 1989 to Nov 08 1989
Cruise H222, Sawtooth Bongo
Nov 01 1990 to Nov 05 1990
Cruise H235, Sawtooth Bongo
Nov 02 1991 to Nov 10 1991
Cruise Z049, Sawtooth Bongo
Nov 24 1992 to Nov 30 1992

Fig. 8.2.2. Larval Herring Program-Georges Bank Cruises: Stage II CHW and Stage III haddock eggs.

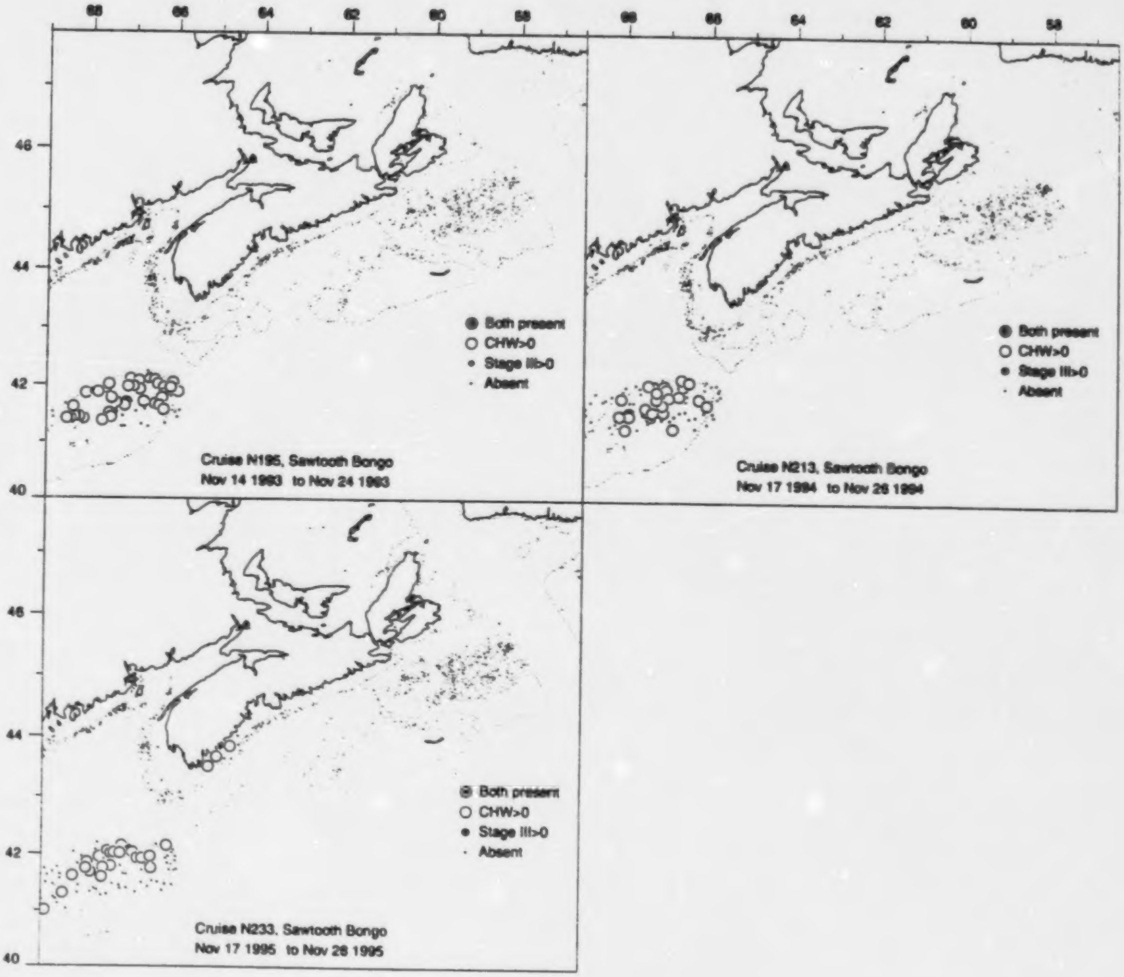

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise N195, Sawtooth Bongo
Nov 14 1993 to Nov 24 1993
Cruise N213, Sawtooth Bongo
Nov 17 1994 to Nov 26 1994
Cruise N233, Sawtooth Bongo
Nov 17 1995 to Nov 26 1995

Fig. 8.2.2. (continued).

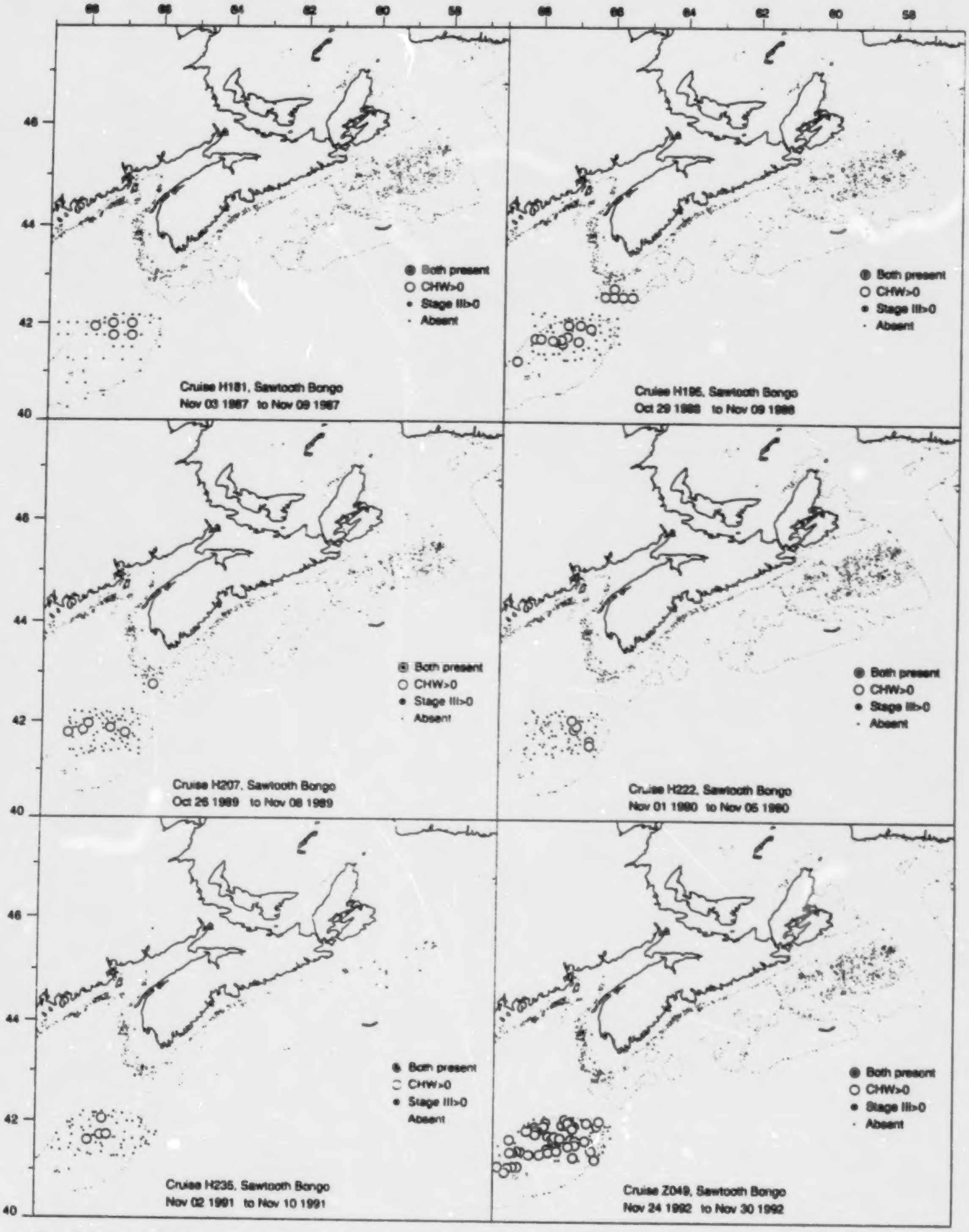

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H181, Sawtooth Bongo
Nov 03 1987 to Nov 09 1987
Cruise H196, Sawtooth Bongo
Oct 29 1988 to Nov 09 1988
Cruise H207, Sawtooth Bongo
Oct 26 1989 to Nov 08 1989
Cruise H222, Sawtooth Bongo
Nov 01 1990 to Nov 05 1990
Cruise H235, Sawtooth Bongo
Nov 02 1991 to Nov 10 1991
Cruise Z049, Sawtooth Bongo
Nov 24 1992 to Nov 30 1992

Fig. 8.2.3. Larval Herring Program-Georges Bank Cruises: Stage III CHW and Stage III haddock eggs.

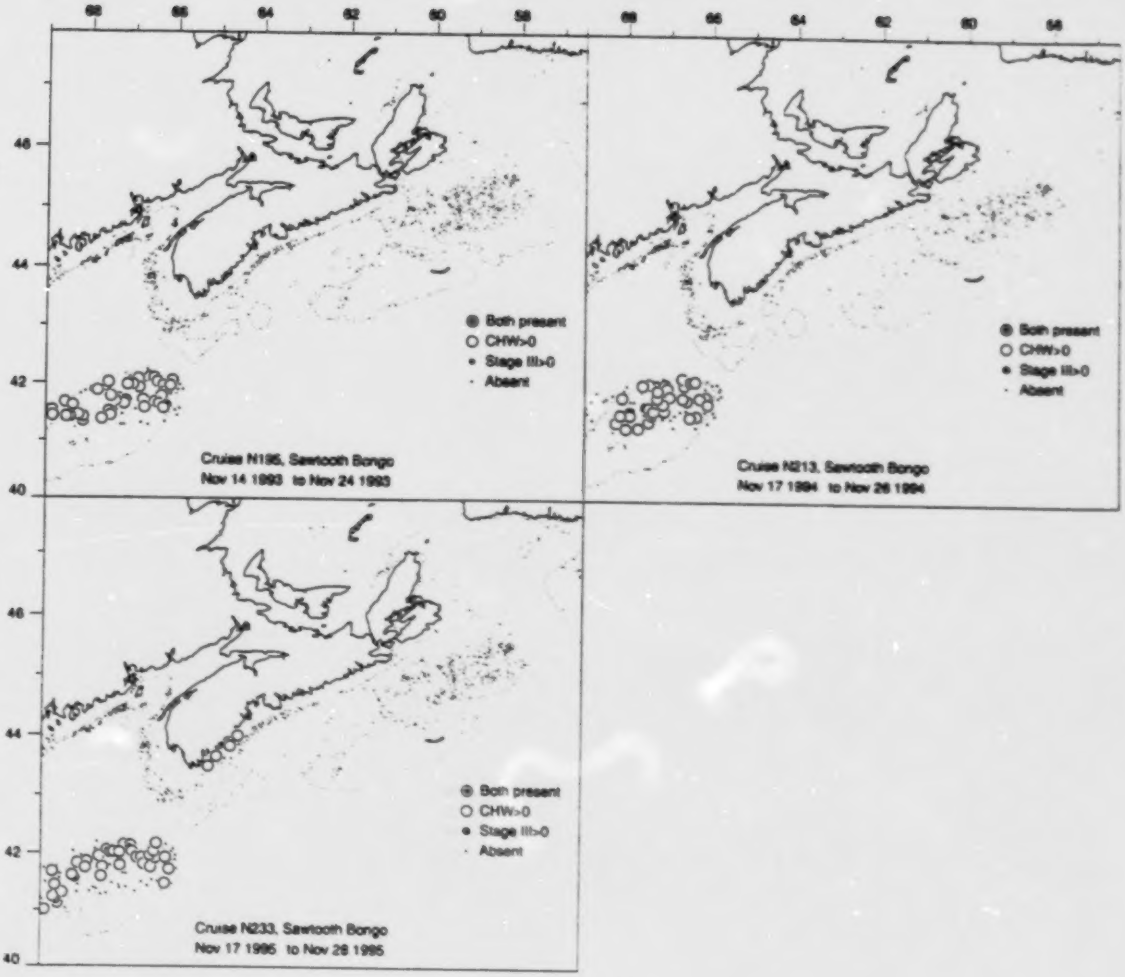

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise N195, Sawtooth Bongo
Nov 14 1993 to Nov 24 1993
Cruise N213, Sawtooth Bongo
Nov 17 1994 to Nov 28 1994
Cruise N233, Sawtooth Bongo
Nov 17 1995 to Nov 28 1995

Fig. 8.2.3. (continued).

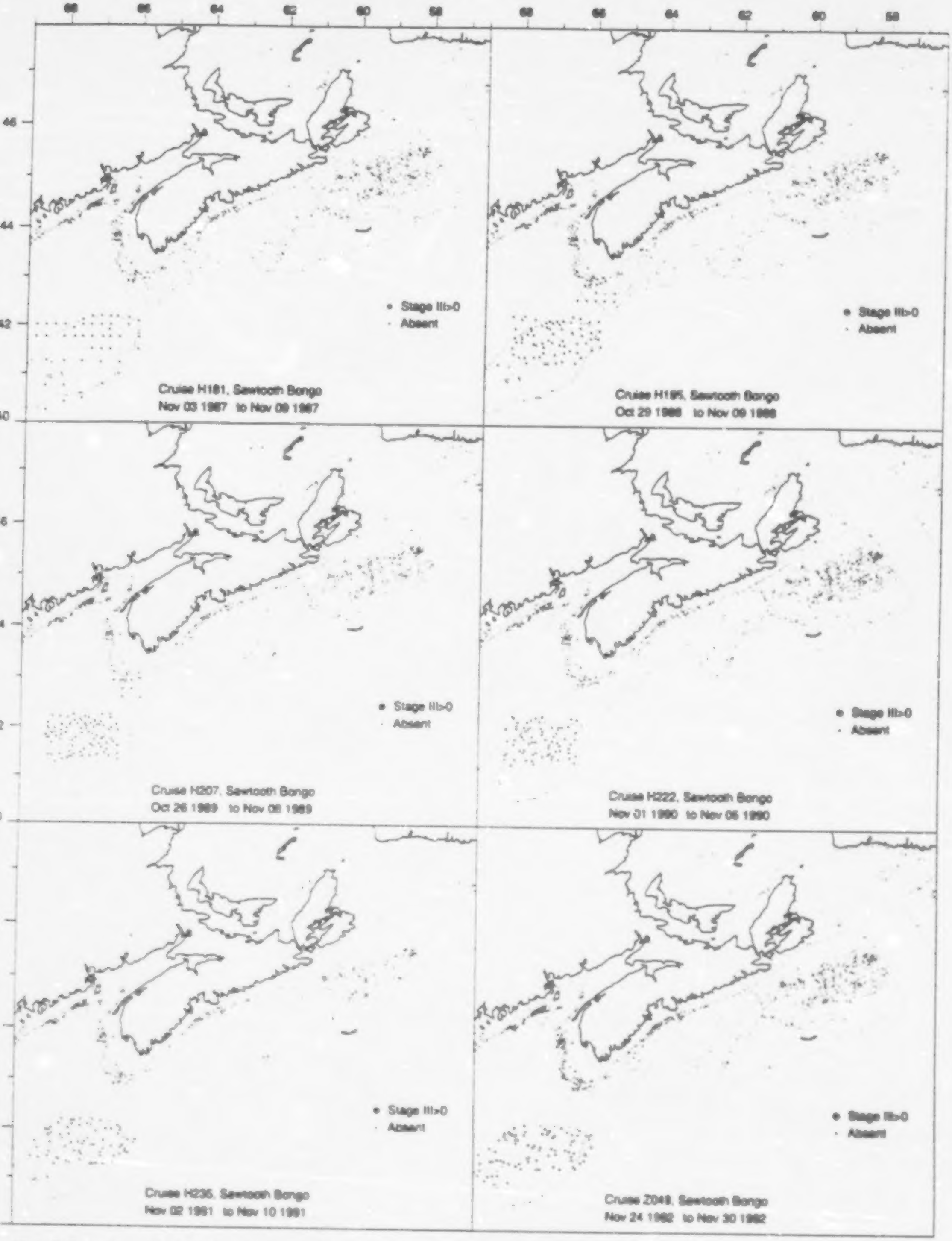

68
66
64
62
60
58
46
44
42
40
Stage III>0
Absent
Cruise H181, Sawtooth Bongo
Nov 03 1987 to Nov 09 1987
Cruise H195, Sawtooth Bongo
Oct 29 1988 to Nov 09 1988
Cruise H207, Sawtooth Bongo
Oct 26 1989 to Nov 06 1989
Cruise H222, Sawtooth Bongo
Nov 01 1990 to Nov 06 1990
Cruise H235, Sawtooth Bongo
Nov 02 1991 to Nov 10 1991
Cruise Z049, Sawtooth Bongo
Nov 24 1992 to Nov 30 1992

Fig. 8.2.4. Larval Herring Program-Georges Bank Cruises: Stage III haddock eggs.

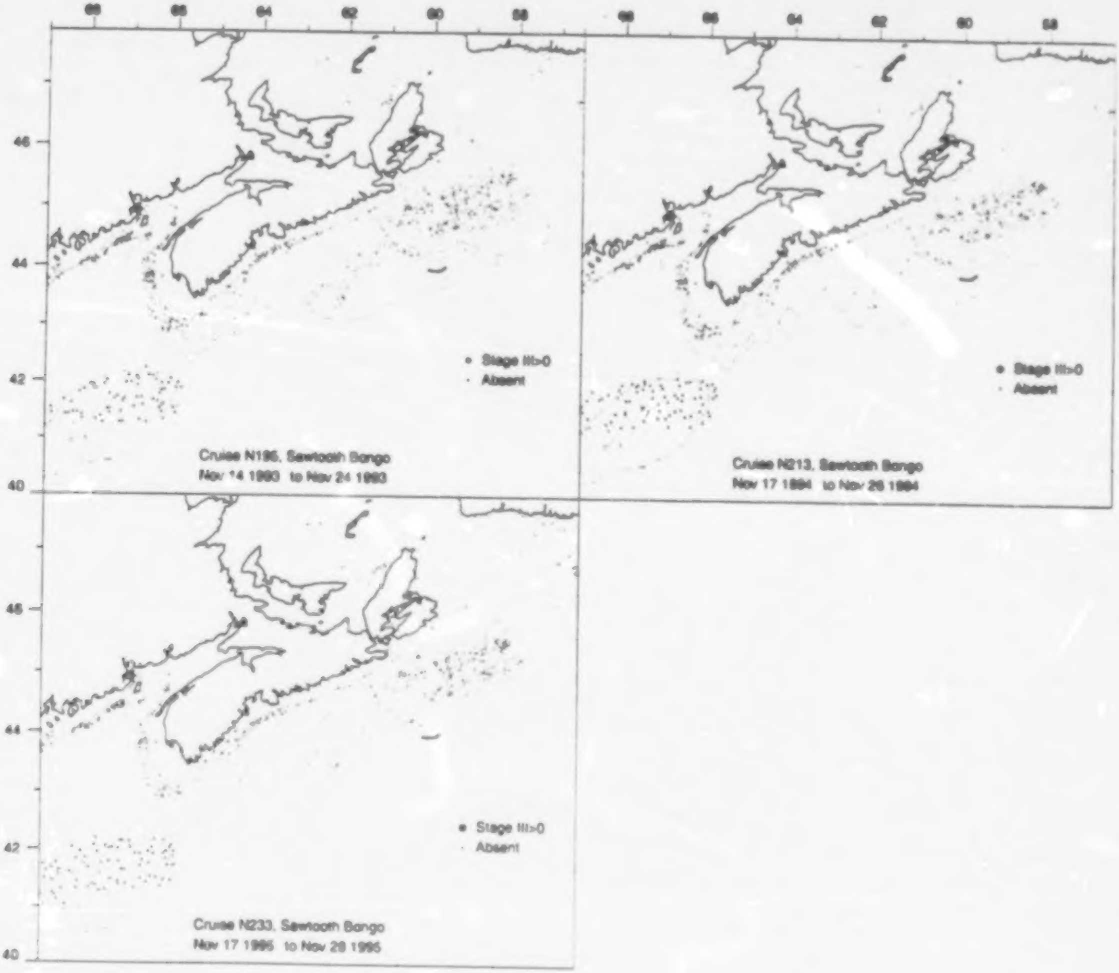

68
66
64
62
60
58
46
44
42
40
Stage III>0
Absent
Cruise N196, Sawtooth Bongo
Nov 14 1993 to Nov 24 1993
Cruise N213, Sawtooth Bongo
Nov 17 1994 to Nov 26 1994
Cruise N233, Sawtooth Bongo
Nov 17 1995 to Nov 28 1995

Fig. 8.2.4. (continued).

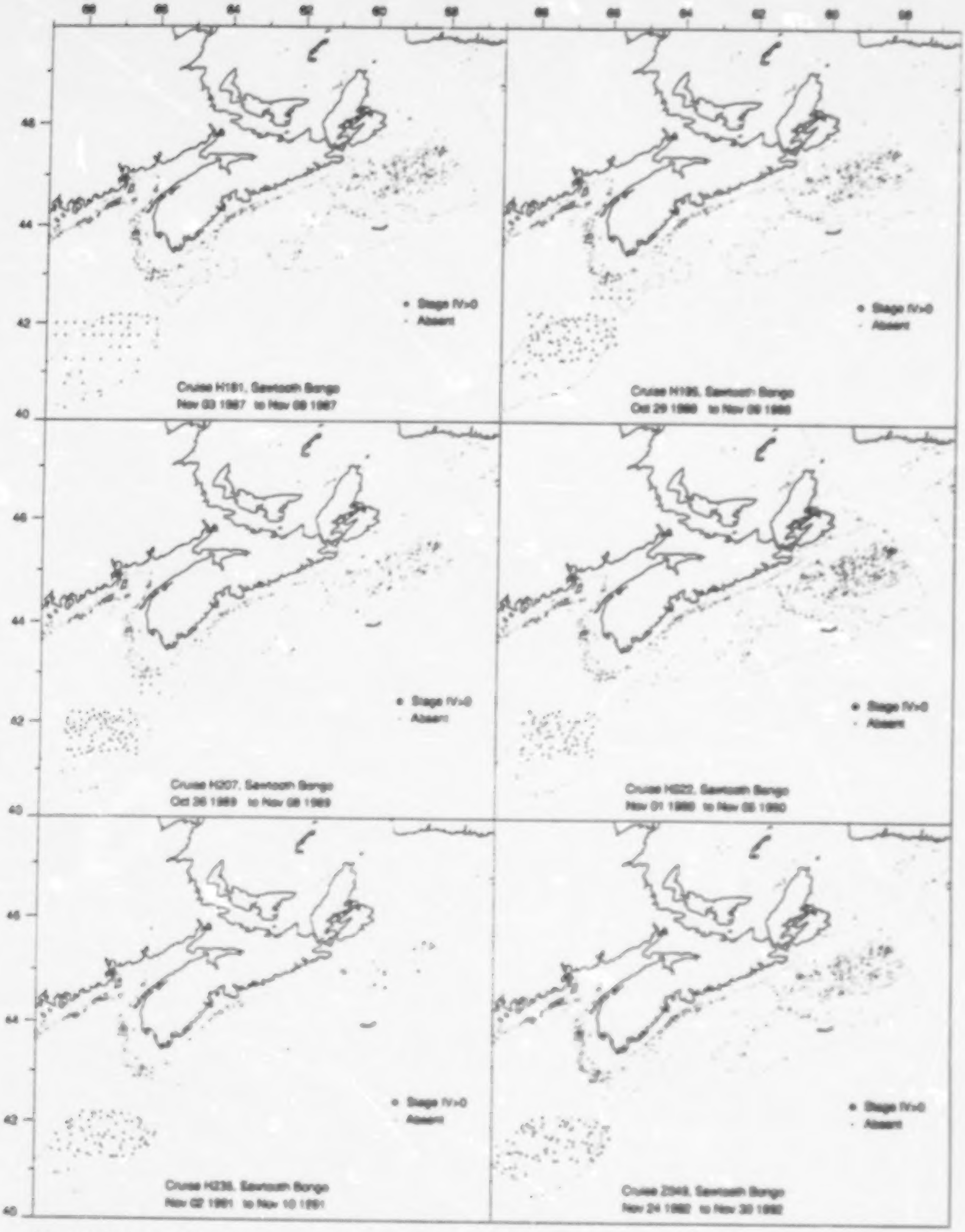

68
66
64
62
60
58
46
44
42
40
● Stage IV>0
· Absent
Cruise H181, Sawtooth Bongo
Nov 03 1987 to Nov 09 1987
Cruise H195, Sawtooth Bongo
Oct 29 1988 to Nov 08 1988
Cruise H207, Sawtooth Bongo
Oct 26 1989 to Nov 08 1989
Cruise H222, Sawtooth Bongo
Nov 01 1990 to Nov 08 1990
Cruise H236, Sawtooth Bongo
Nov 02 1991 to Nov 10 1991
Cruise 2049, Sawtooth Bongo
Nov 24 1992 to Nov 30 1992

Fig. 8.2.5. Larval Herring Program-Georges Bank Cruises: Stage IV haddock eggs.

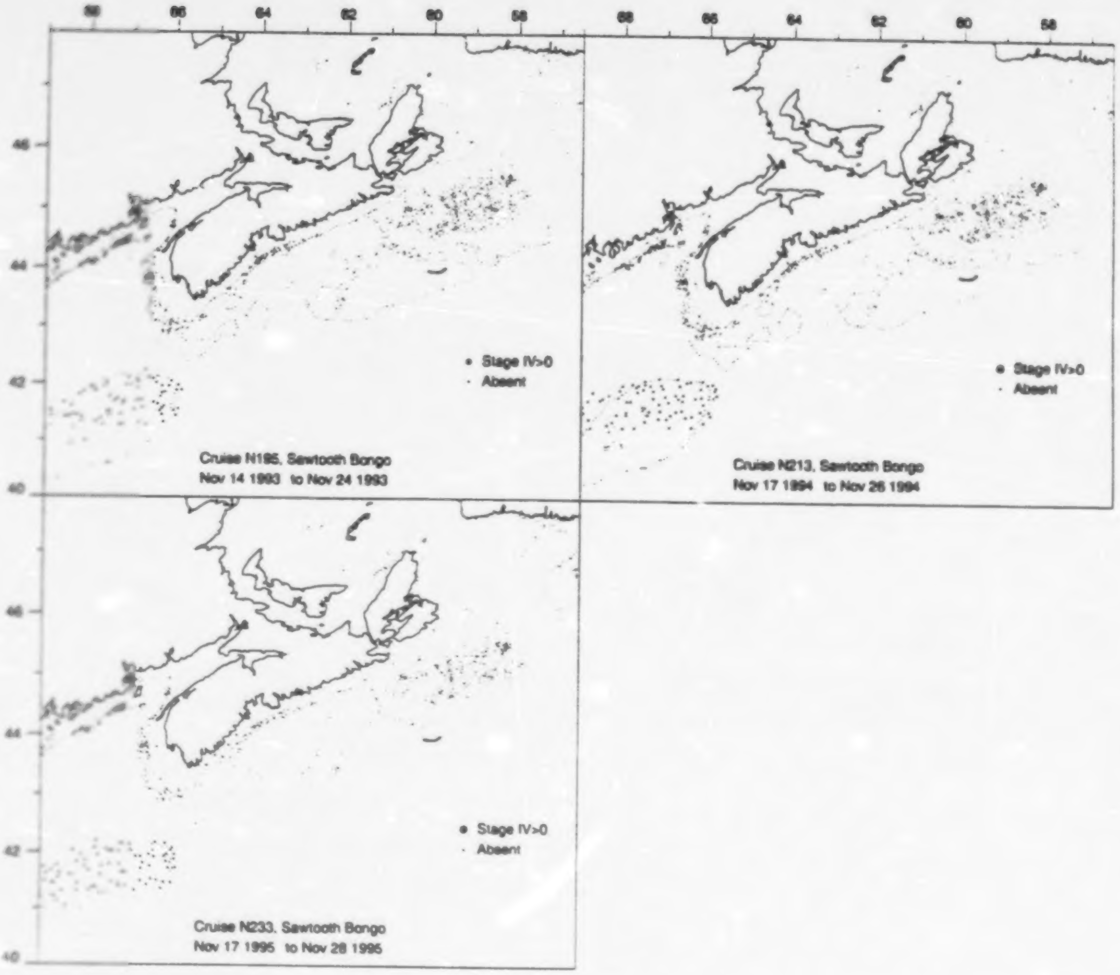

68
66
64
62
60
58
46
44
42
40
● Stage IV>0
· Absent
Cruise N195, Sawtooth Bongo
Nov 14 1993 to Nov 24 1993
Cruise N213, Sawtooth Bongo
Nov 17 1994 to Nov 26 1994
Cruise N233, Sawtooth Bongo
Nov 17 1995 to Nov 28 1995

Fig. 8.2.5. (continued).

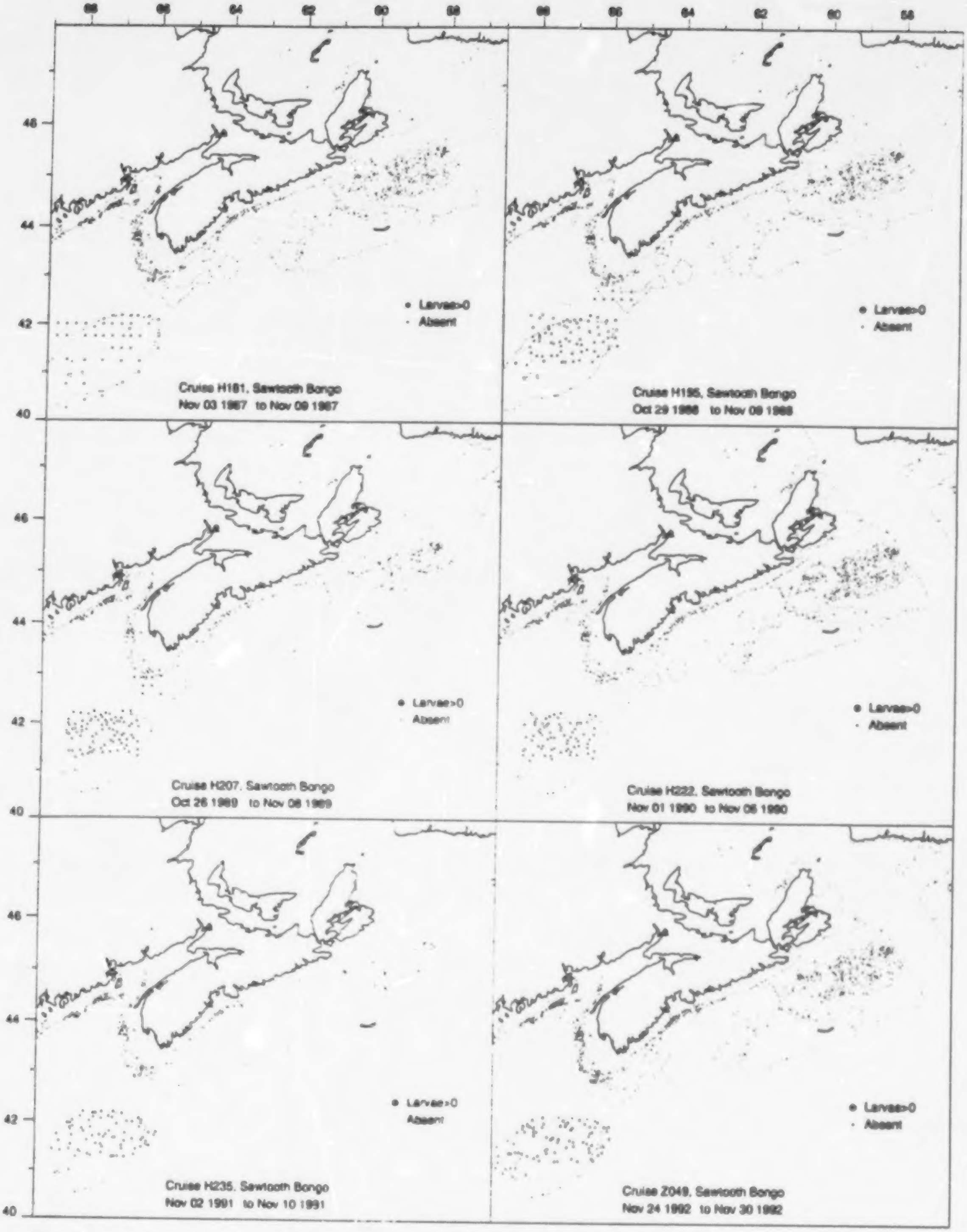

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
● Larvae>0
· Absent
Cruise H181, Sawtooth Bongo
Nov 03 1987 to Nov 09 1987
● Larvae>0
· Absent
Cruise H195, Sawtooth Bongo
Oct 29 1988 to Nov 09 1988
46
44
42
40
● Larvae>0
· Absent
Cruise H207, Sawtooth Bongo
Oct 26 1989 to Nov 08 1989
● Larvae>0
· Absent
Cruise H222, Sawtooth Bongo
Nov 01 1990 to Nov 06 1990
46
44
42
40
● Larvae>0
· Absent
Cruise H235, Sawtooth Bongo
Nov 02 1991 to Nov 10 1991
● Larvae>0
· Absent
Cruise Z049, Sawtooth Bongo
Nov 24 1992 to Nov 30 1992

Fig. 8.2.6. Larval Herring Program-Georges Bank Cruises: Haddock larvae (1-7mm).

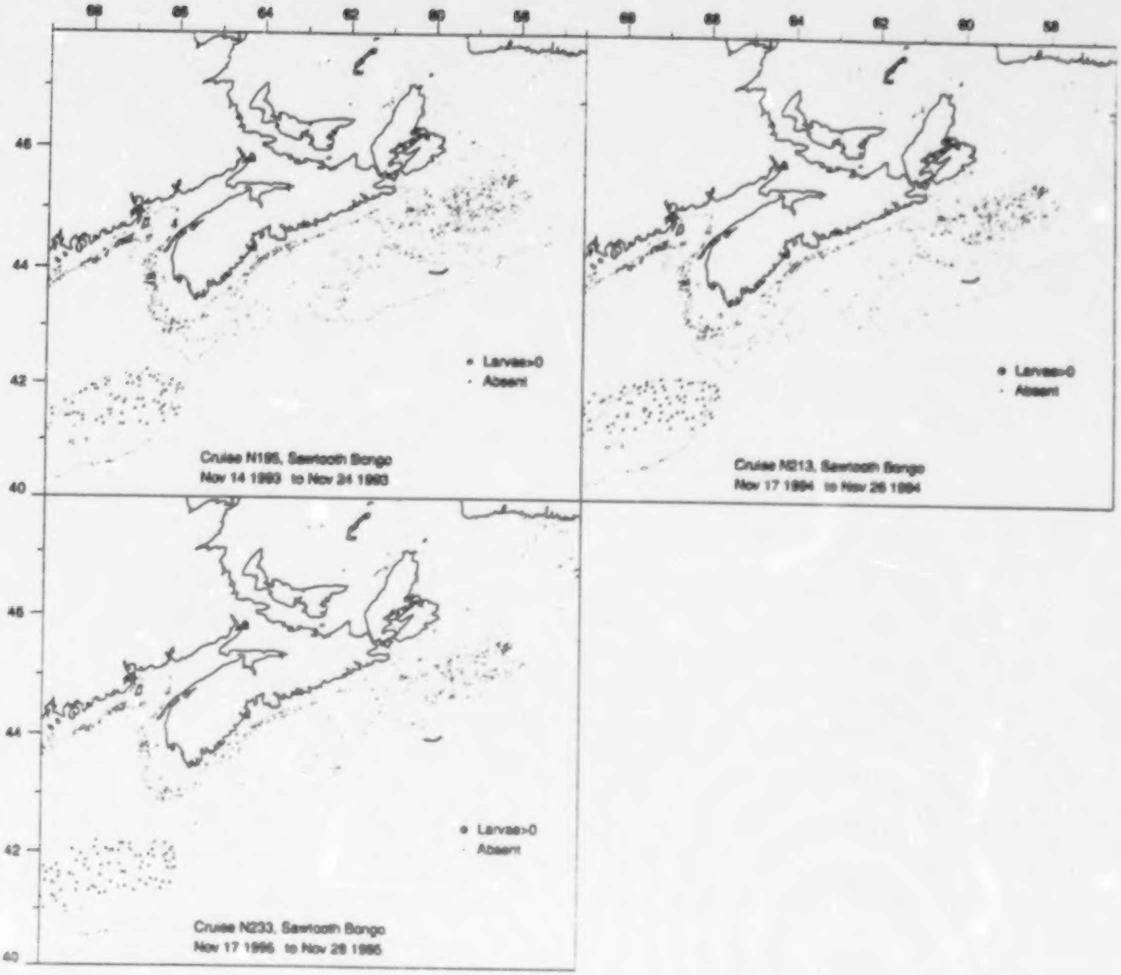

68
66
64
62
60
58
46
44
42
40
• Larvae>0
· Absent
Cruise N195, Sawtooth Bongo
Nov 14 1993 to Nov 24 1993
Cruise N213, Sawtooth Bongo
Nov 17 1994 to Nov 26 1994
Cruise N233, Sawtooth Bongo
Nov 17 1995 to Nov 28 1995

Fig. 8.2.6. (continued).

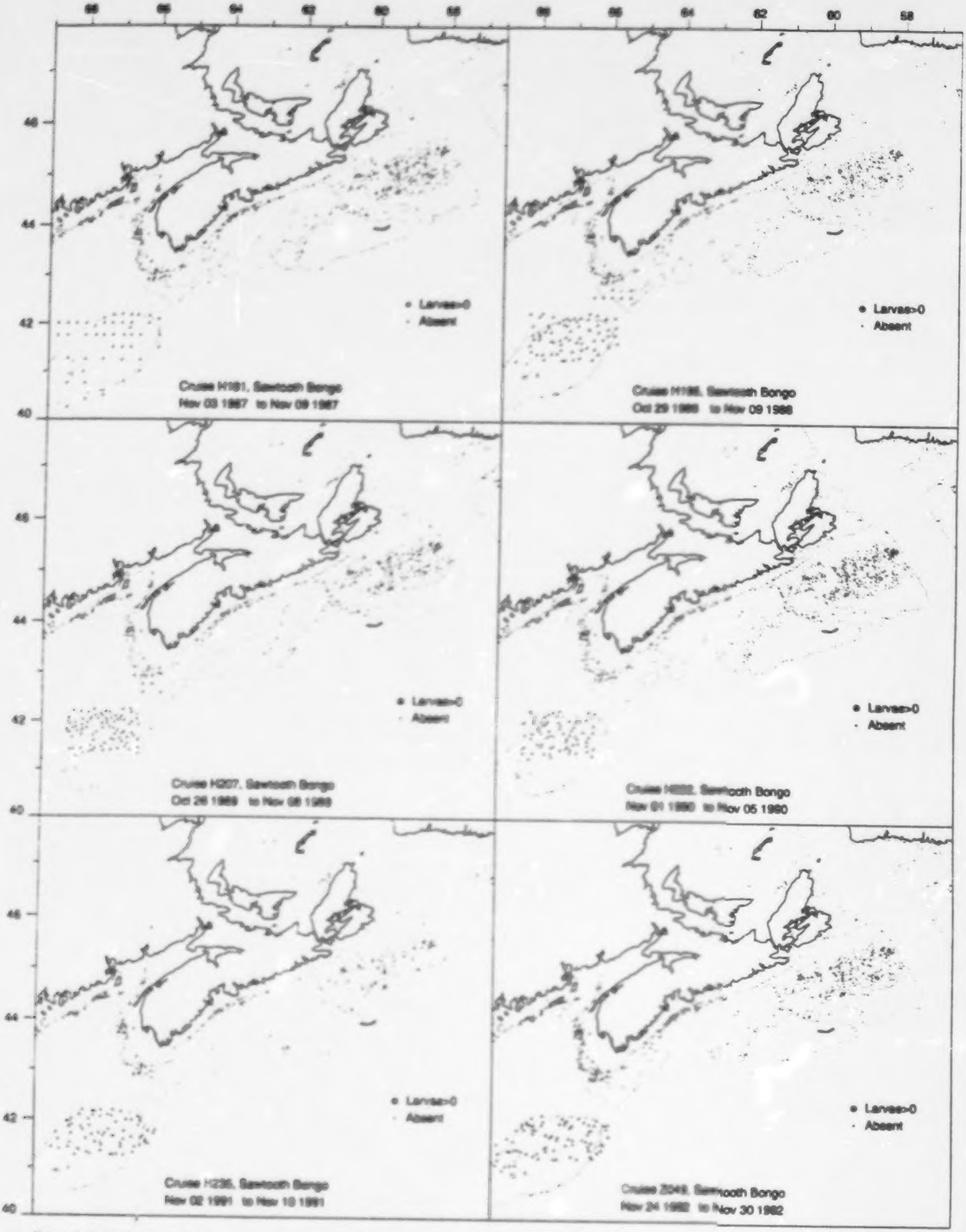

68
66
64
62
60
58
46
44
42
40
● Larvae>0
· Absent
Cruise H181, Sawtooth Bongo
Nov 03 1987 to Nov 09 1987
Cruise H186, Sawtooth Bongo
Oct 29 1988 to Nov 09 1988
Cruise H207, Sawtooth Bongo
Oct 26 1989 to Nov 08 1989
Cruise H222, Sawtooth Bongo
Nov 01 1990 to Nov 05 1990
Cruise H236, Sawtooth Bongo
Nov 02 1991 to Nov 10 1991
Cruise Z049, Sawtooth Bongo
Nov 24 1992 to Nov 30 1992

Fig. 8.2.7. Larval Herring Program-Georges Bank Cruises: Haddock larvae (7+mm).

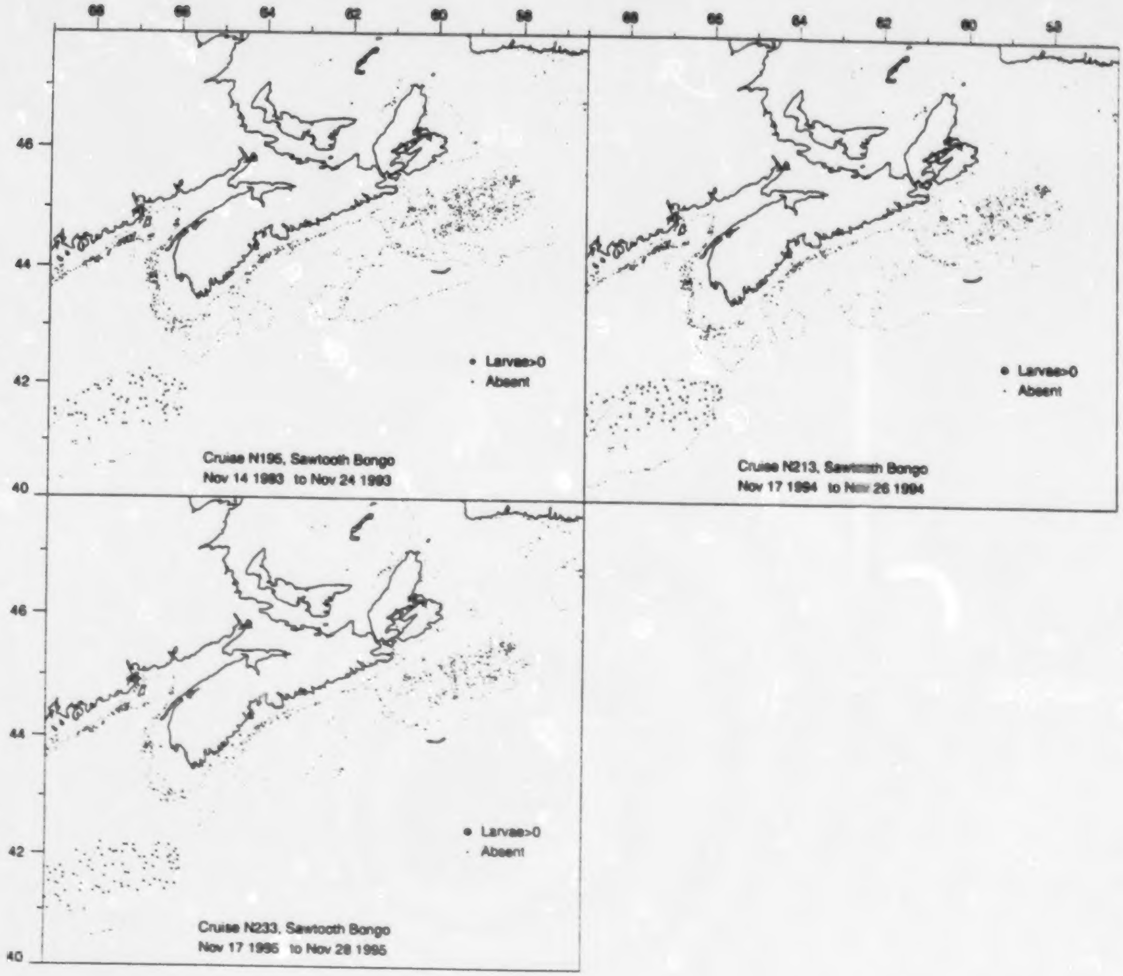
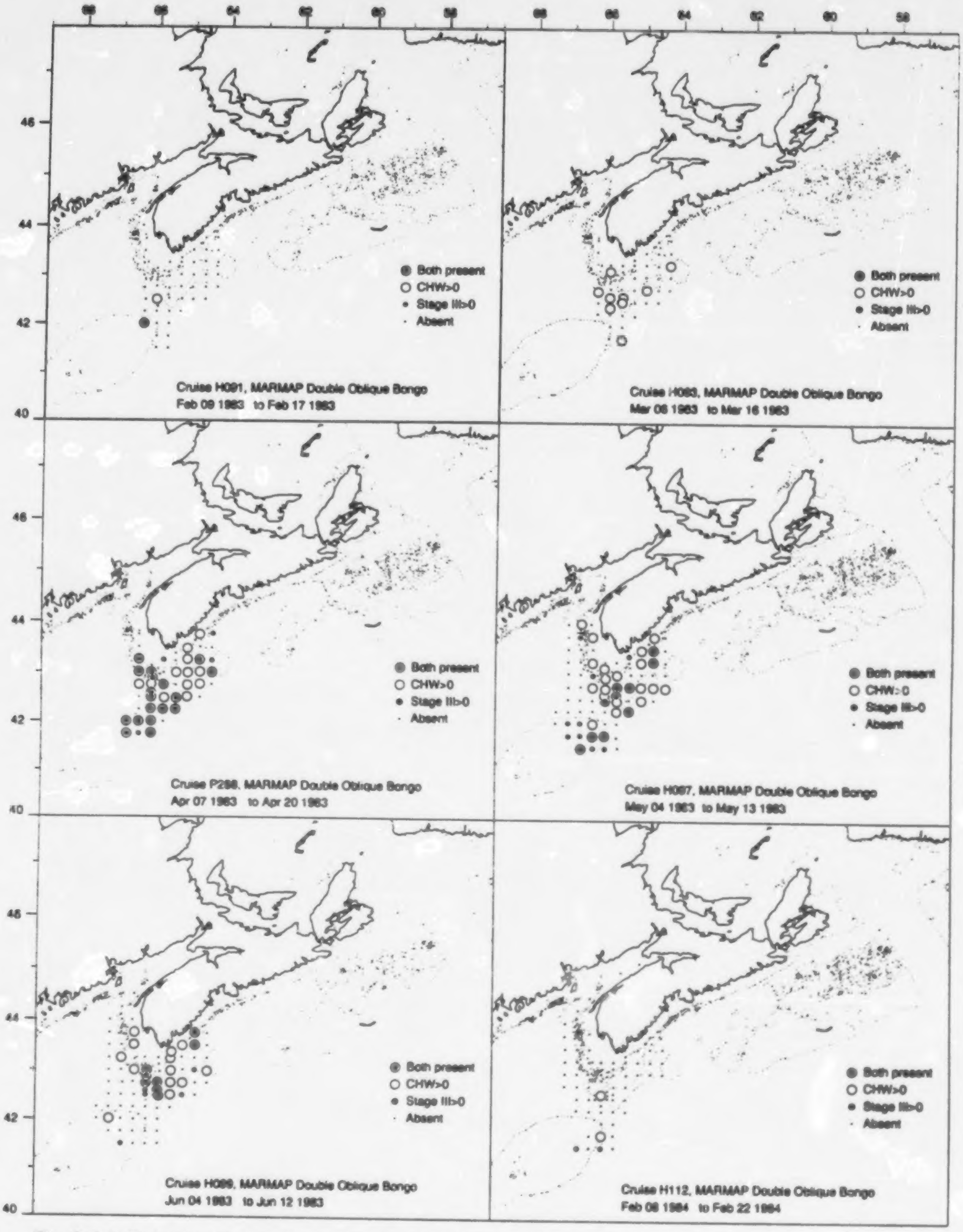

68
66
64
62
60
58
46
44
42
40
● Larvae>0
· Absent
Cruise N196, Sawtooth Bongo
Nov 14 1993 to Nov 24 1993
68
66
64
62
60
58
● Larvae>0
· Absent
Cruise N213, Sawtooth Bongo
Nov 17 1994 to Nov 26 1994
46
44
42
40
● Larvae>0
· Absent
Cruise N233, Sawtooth Bongo
Nov 17 1995 to Nov 28 1995

Fig. 8.2.7. (continued).


68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent

Cruise H091, MARMAP Double Oblique Bongo
Feb 09 1983 to Feb 17 1983

Cruise H093, MARMAP Double Oblique Bongo
Mar 06 1983 to Mar 16 1983

Cruise P288, MARMAP Double Oblique Bongo
Apr 07 1983 to Apr 20 1983

Cruise H097, MARMAP Double Oblique Bongo
May 04 1983 to May 13 1983

Cruise H099, MARMAP Double Oblique Bongo
Jun 04 1983 to Jun 12 1983

Cruise H112, MARMAP Double Oblique Bongo
Feb 08 1984 to Feb 22 1984

Fig. 8.3.1. Fisheries Ecology Program Cruises: Stage I CHW and Stage III haddock eggs.

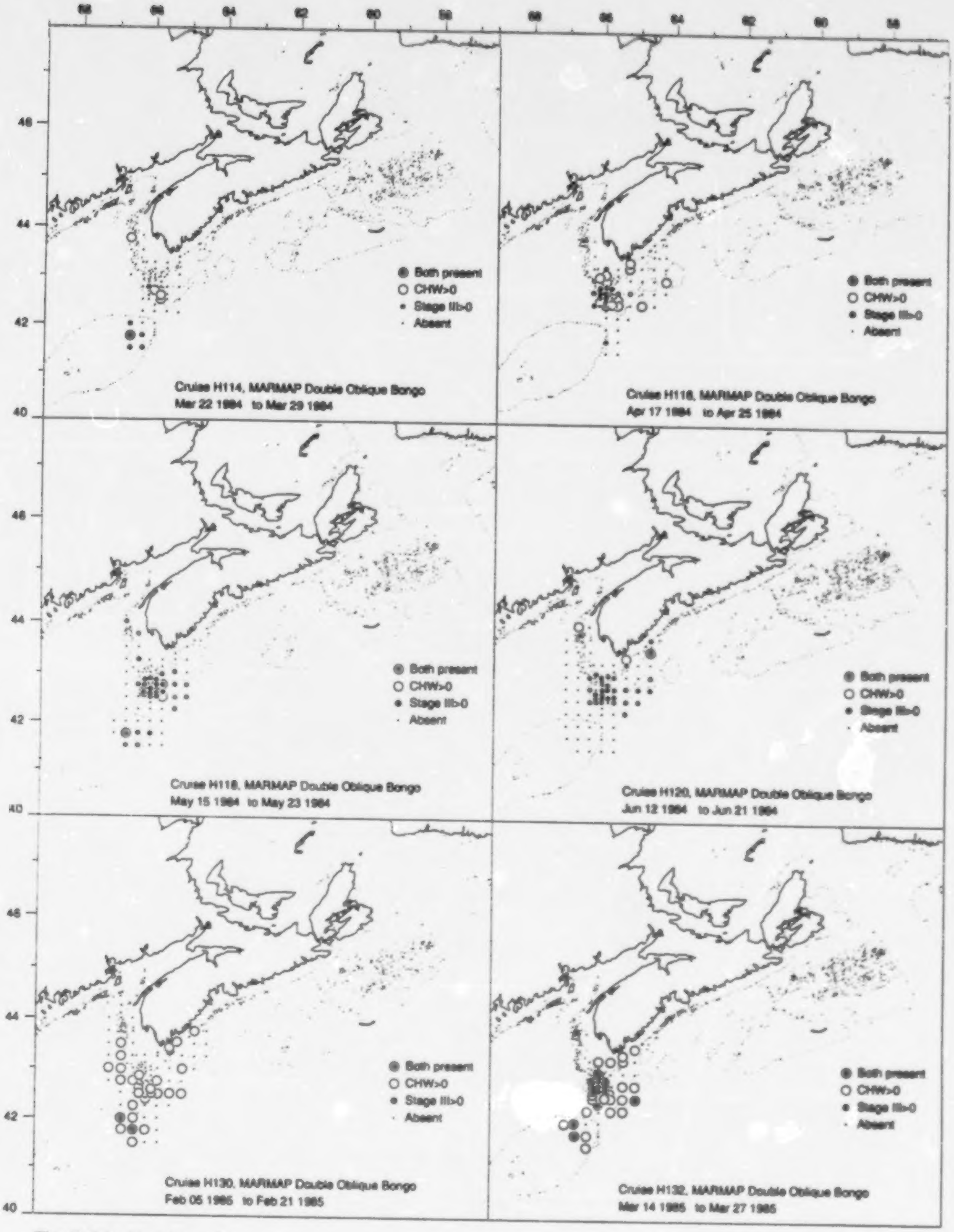

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H114, MARMAP Double Oblique Bongo
Mar 22 1984 to Mar 29 1984
Cruise H116, MARMAP Double Oblique Bongo
Apr 17 1984 to Apr 25 1984
Cruise H118, MARMAP Double Oblique Bongo
May 15 1984 to May 23 1984
Cruise H120, MARMAP Double Oblique Bongo
Jun 12 1984 to Jun 21 1984
Cruise H130, MARMAP Double Oblique Bongo
Feb 05 1985 to Feb 21 1985
Cruise H132, MARMAP Double Oblique Bongo
Mar 14 1985 to Mar 27 1985

Fig. 8.3.1. (continued).

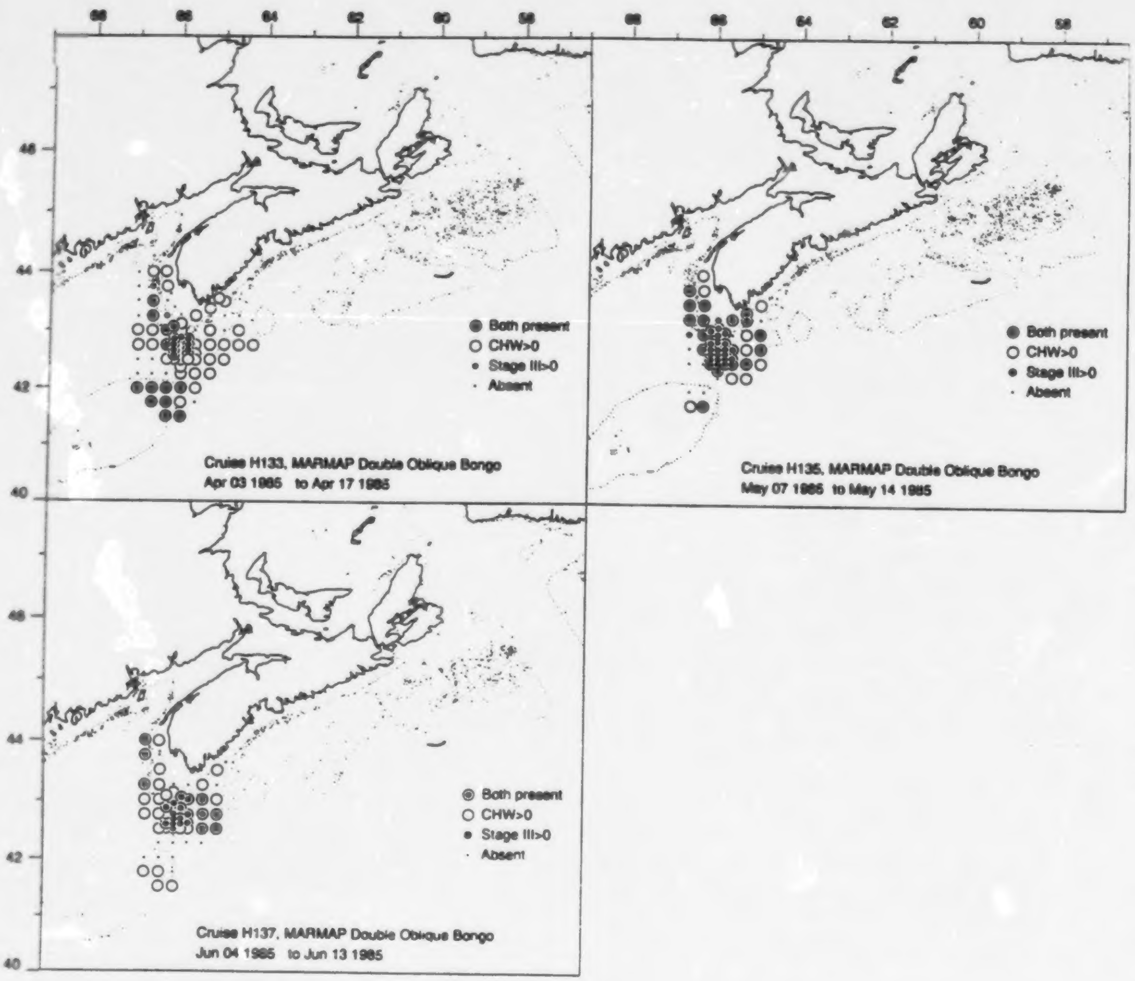

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H133, MARMAP Double Oblique Bongo
Apr 03 1985 to Apr 17 1985
Cruise H135, MARMAP Double Oblique Bongo
May 07 1985 to May 14 1985
Cruise H137, MARMAP Double Oblique Bongo
Jun 04 1985 to Jun 13 1985

Fig. 8.3.1. (continued).

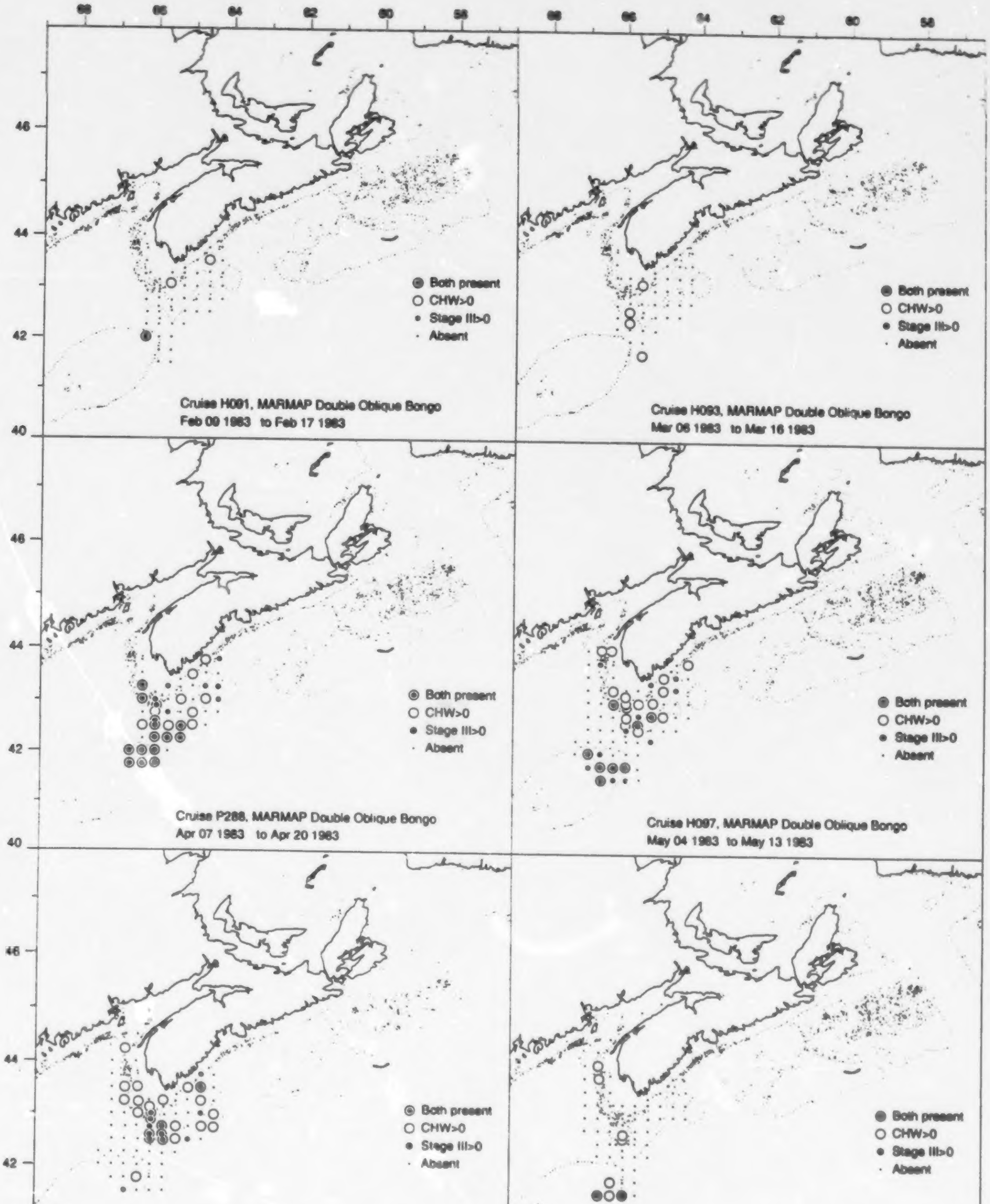
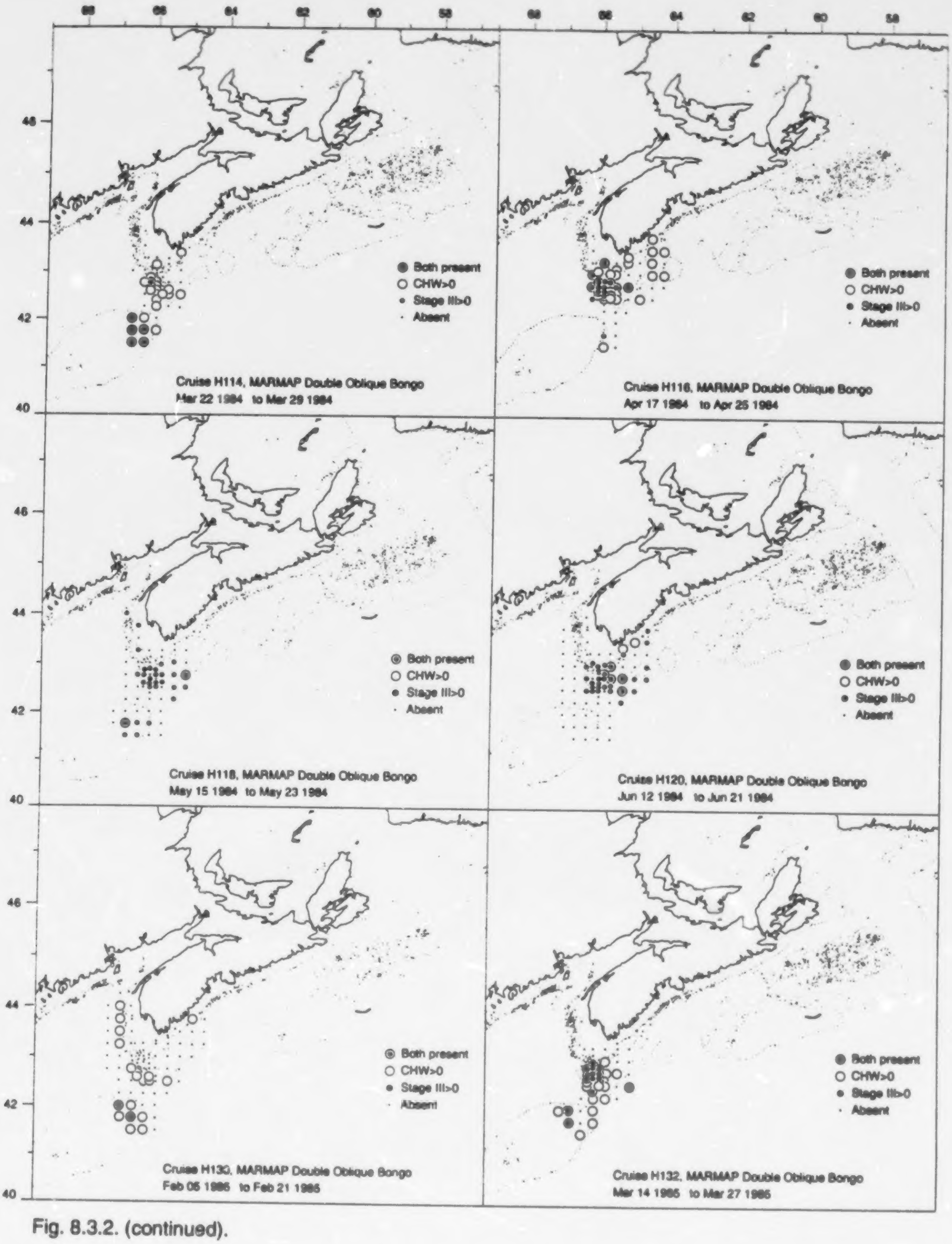

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H091, MARMAP Double Oblique Bongo
Feb 09 1983 to Feb 17 1983
Cruise H093, MARMAP Double Oblique Bongo
Mar 06 1983 to Mar 16 1983
Cruise P288, MARMAP Double Oblique Bongo
Apr 07 1983 to Apr 20 1983
Cruise H097, MARMAP Double Oblique Bongo
May 04 1983 to May 13 1983
Cruise H099, MARMAP Double Oblique Bongo
Jun 04 1983 to Jun 12 1983
Cruise H112, MARMAP Double Oblique Bongo
Feb 08 1984 to Feb 22 1984

Fig. 8.3.2. Fisheries Ecology Program Cruises: Stage II CHW and Stage III haddock eggs.


68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent

Cruise H114, MARMAP Double Oblique Bongo
Mar 22 1984 to Mar 29 1984

Cruise H116, MARMAP Double Oblique Bongo
Apr 17 1984 to Apr 25 1984

Cruise H118, MARMAP Double Oblique Bongo
May 15 1984 to May 23 1984

Cruise H120, MARMAP Double Oblique Bongo
Jun 12 1984 to Jun 21 1984

Cruise H130, MARMAP Double Oblique Bongo
Feb 05 1985 to Feb 21 1985

Cruise H132, MARMAP Double Oblique Bongo
Mar 14 1985 to Mar 27 1985

Fig. 8.3.2. (continued).

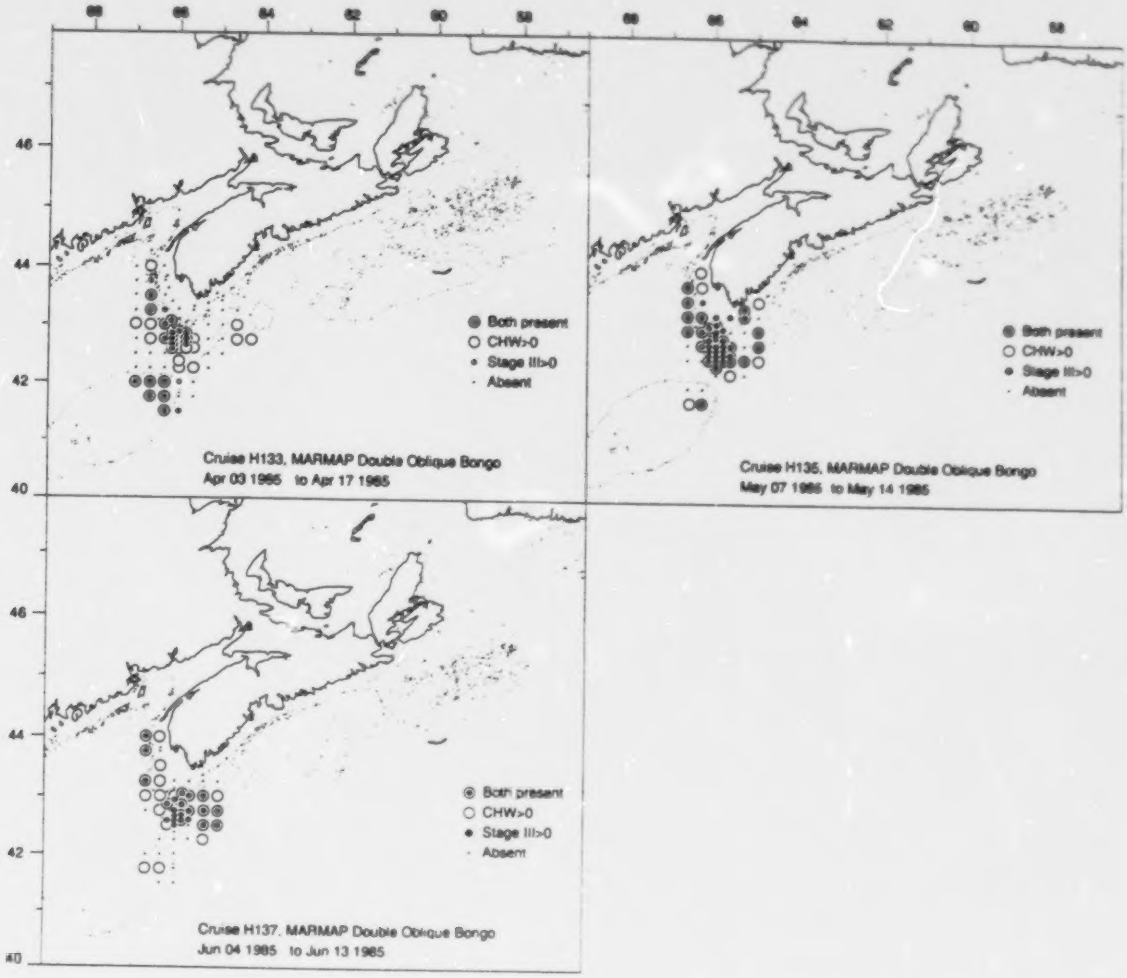

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H133, MARMAP Double Oblique Bongo
Apr 03 1985 to Apr 17 1985
Cruise H135, MARMAP Double Oblique Bongo
May 07 1985 to May 14 1985
Cruise H137, MARMAP Double Oblique Bongo
Jun 04 1985 to Jun 13 1985

Fig. 8.3.2. (continued).

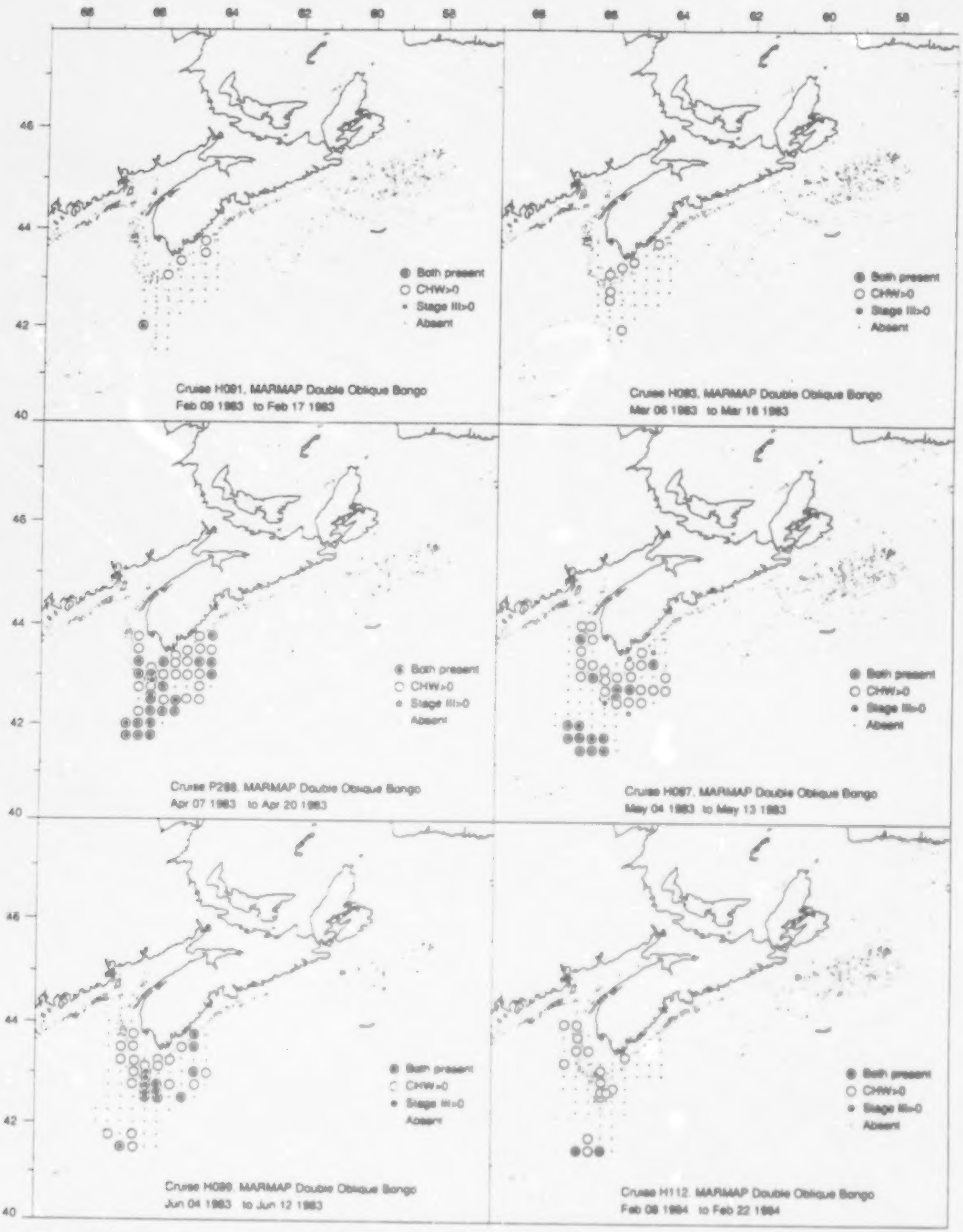

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise H091, MARMAP Double Oblique Bongo
Feb 09 1983 to Feb 17 1983
Cruise H093, MARMAP Double Oblique Bongo
Mar 06 1983 to Mar 16 1983
Cruise P288, MARMAP Double Oblique Bongo
Apr 07 1983 to Apr 20 1983
Cruise H097, MARMAP Double Oblique Bongo
May 04 1983 to May 13 1983
Cruise H099, MARMAP Double Oblique Bongo
Jun 04 1983 to Jun 12 1983
Cruise H112, MARMAP Double Oblique Bongo
Feb 08 1984 to Feb 22 1984

Fig. 8.3.3. Fisheries Ecology Program Cruises: Stage III CHW and Stage III haddock eggs.

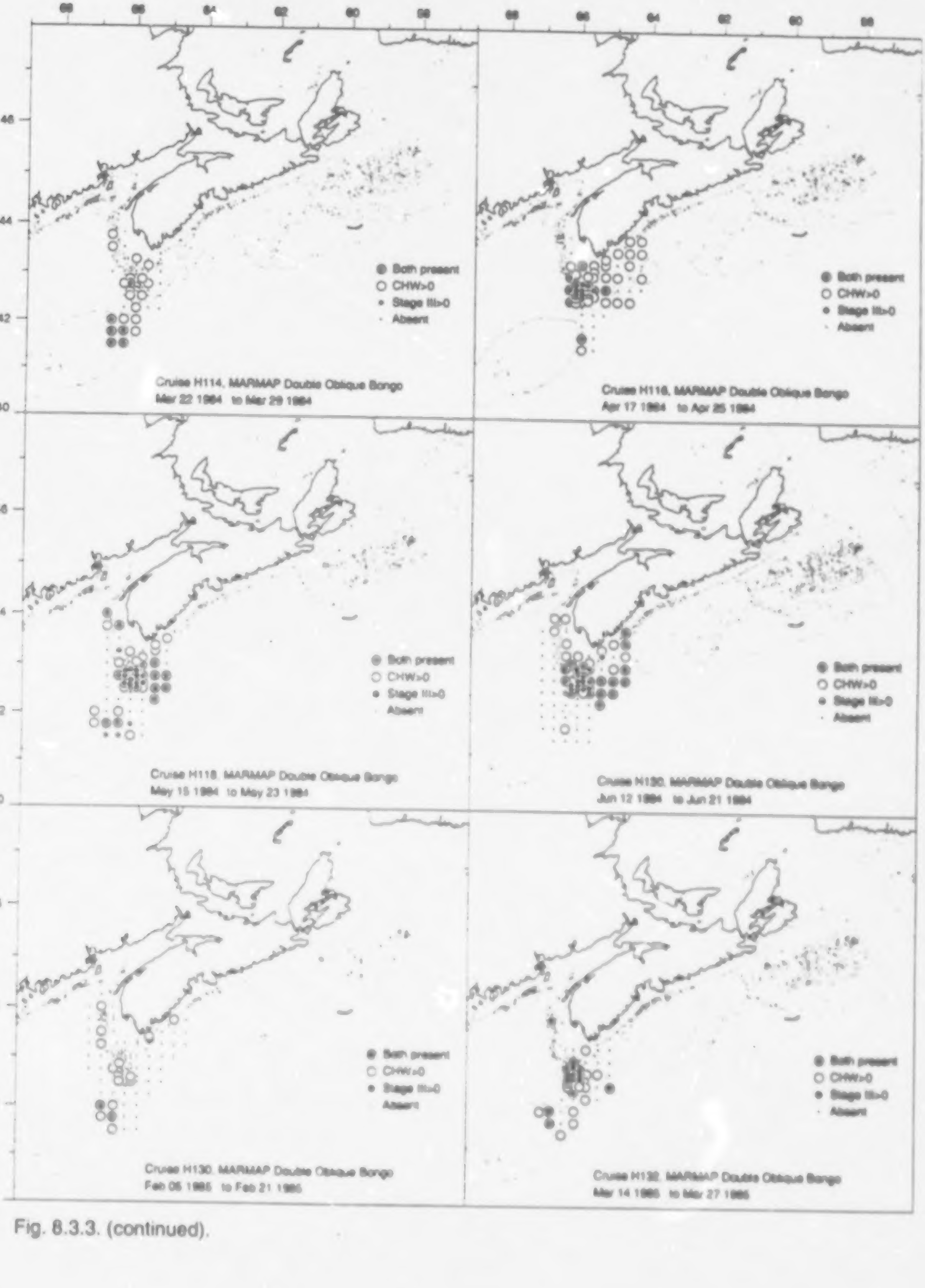
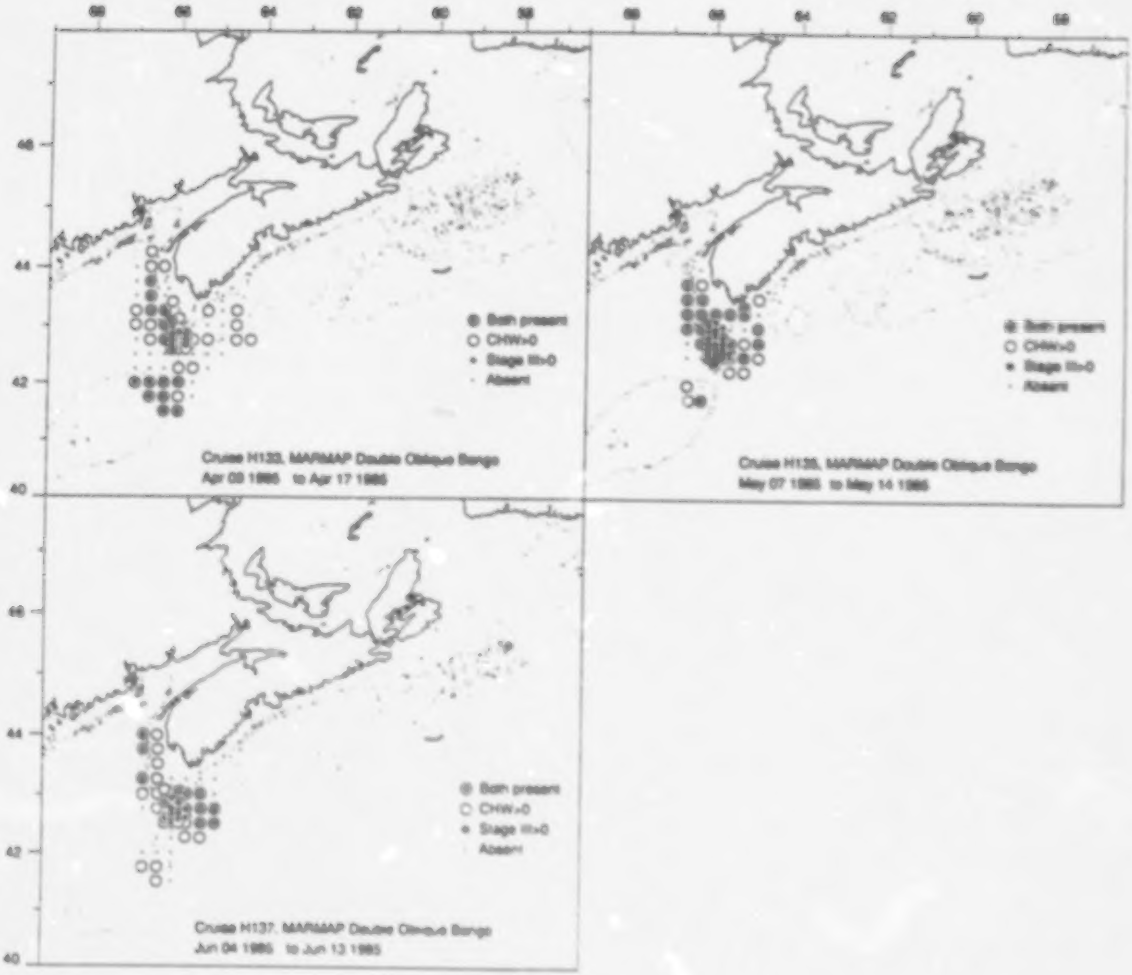

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H114, MARMAP Double Oblique Bongo
Mar 22 1984 to Mar 29 1984
Cruise H116, MARMAP Double Oblique Bongo
Apr 17 1984 to Apr 25 1984
Cruise H118, MARMAP Double Oblique Bongo
May 15 1984 to May 23 1984
Cruise H120, MARMAP Double Oblique Bongo
Jun 12 1984 to Jun 21 1984
Cruise H130, MARMAP Double Oblique Bongo
Feb 05 1985 to Feb 21 1985
Cruise H132, MARMAP Double Oblique Bongo
Mar 14 1985 to Mar 27 1985

Fig. 8.3.3. (continued).


68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent

Cruise H133, MARMAP Double Oblique Bongo
Apr 03 1985 to Apr 17 1985

Cruise H135, MARMAP Double Oblique Bongo
May 07 1985 to May 14 1985

Cruise H137, MARMAP Double Oblique Bongo
Jun 04 1985 to Jun 13 1985

Fig. 8.3.3. (continued).

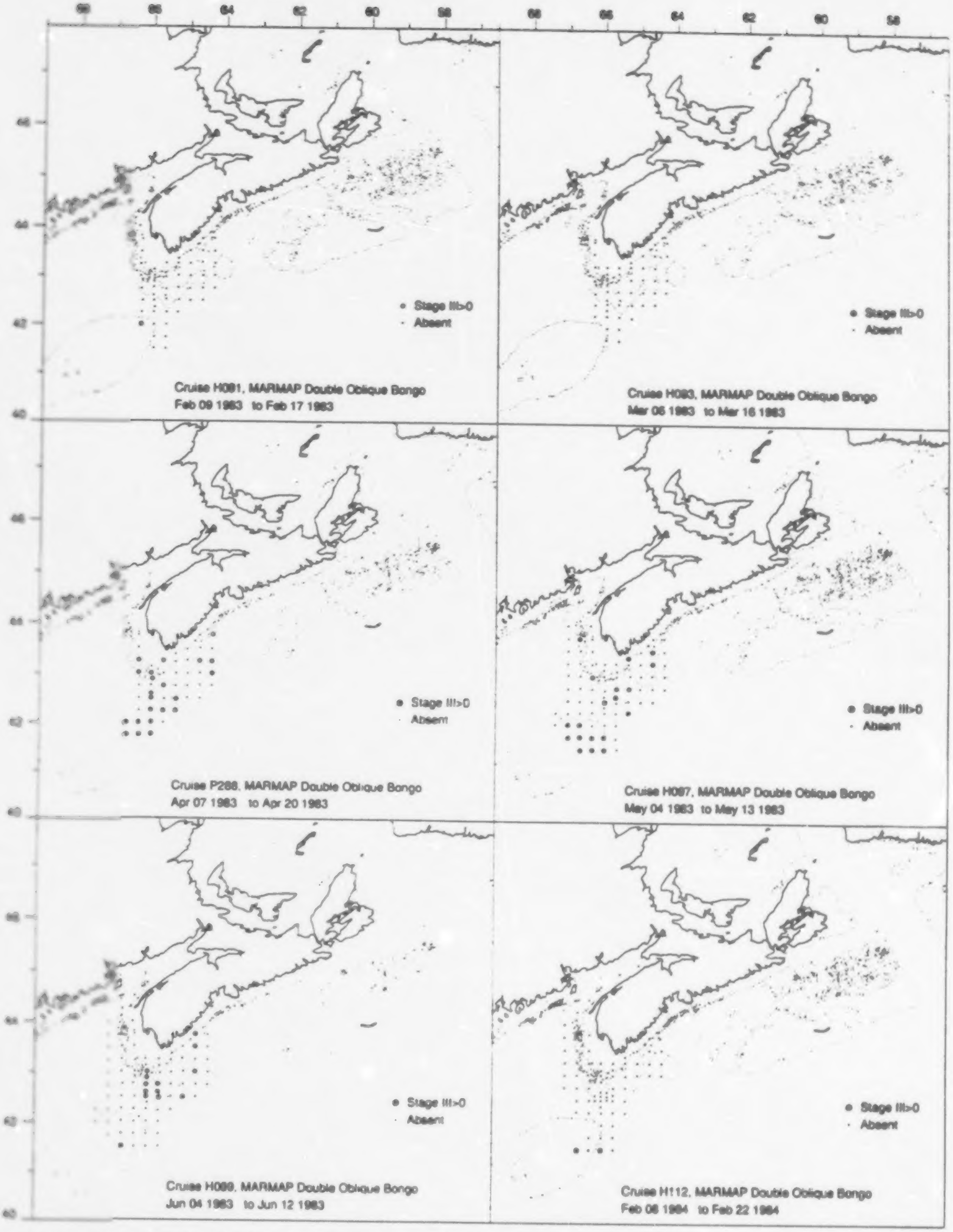
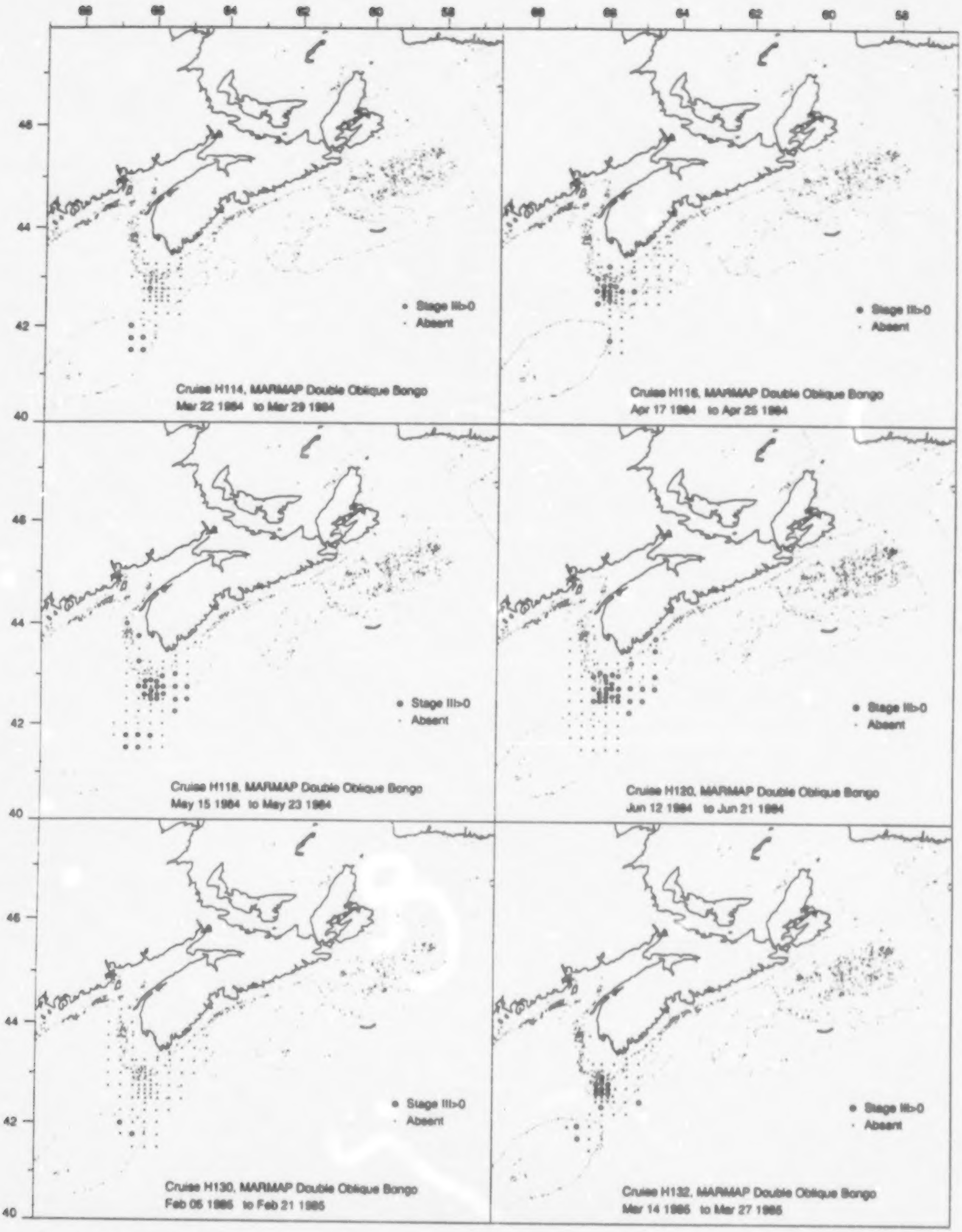

68
66
64
62
60
58
46
44
42
40
● Stage III>0
· Absent
Cruise H081, MARMAP Double Oblique Bongo
Feb 09 1983 to Feb 17 1983
Cruise H083, MARMAP Double Oblique Bongo
Mar 06 1983 to Mar 16 1983
Cruise P288, MARMAP Double Oblique Bongo
Apr 07 1983 to Apr 20 1983
Cruise H087, MARMAP Double Oblique Bongo
May 04 1983 to May 13 1983
Cruise H089, MARMAP Double Oblique Bongo
Jun 04 1983 to Jun 12 1983
Cruise H112, MARMAP Double Oblique Bongo
Feb 08 1984 to Feb 22 1984

Fig. 8.3.4. Fisheries Ecology Program Cruises: Stage III haddock eggs.



Cruise H114, MARMAP Double Oblique Bongo
Mar 22 1984 to Mar 29 1984

Cruise H116, MARMAP Double Oblique Bongo
Apr 17 1984 to Apr 25 1984

Cruise H118, MARMAP Double Oblique Bongo
May 15 1984 to May 23 1984

Cruise H120, MARMAP Double Oblique Bongo
Jun 12 1984 to Jun 21 1984

Cruise H130, MARMAP Double Oblique Bongo
Feb 05 1985 to Feb 21 1985

Cruise H132, MARMAP Double Oblique Bongo
Mar 14 1985 to Mar 27 1985

Fig. 8.3.4. (continued).

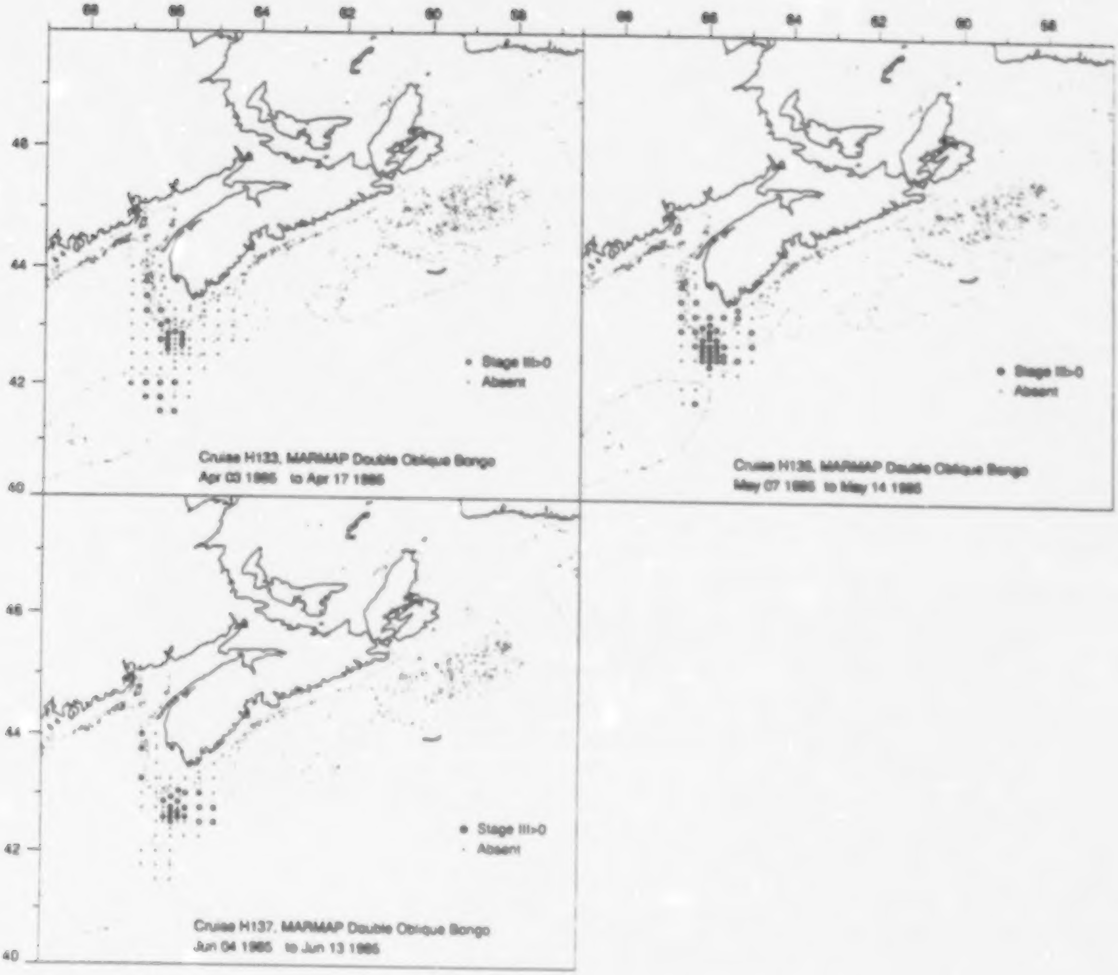

68
66
64
62
60
58
46
44
42
40
Stage III>0
Absent
Cruise H133, MARMAP Double Oblique Bongo
Apr 03 1985 to Apr 17 1985
Cruise H135, MARMAP Double Oblique Bongo
May 07 1985 to May 14 1985
Cruise H137, MARMAP Double Oblique Bongo
Jun 04 1985 to Jun 13 1985

Fig. 8.3.4. (continued).

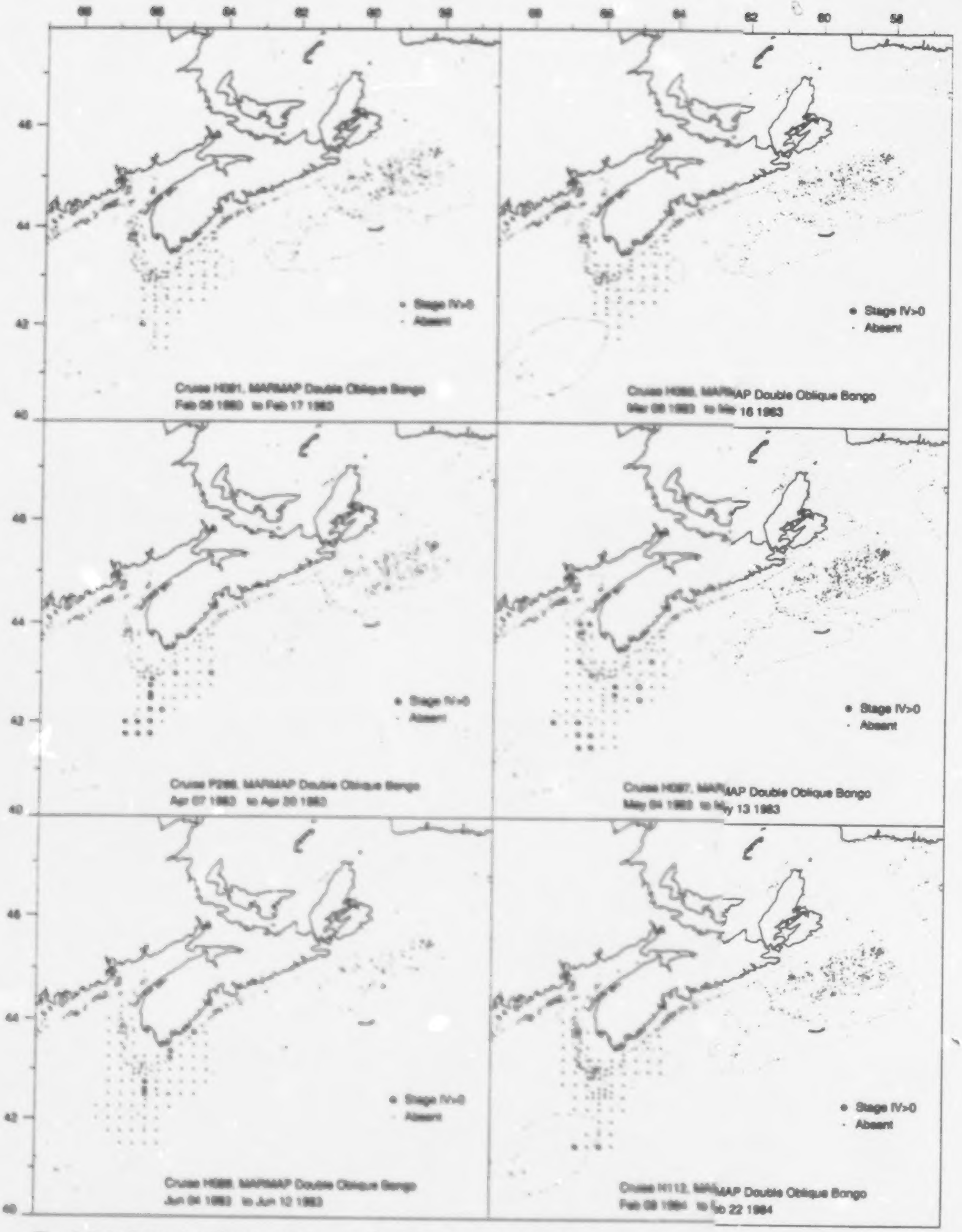
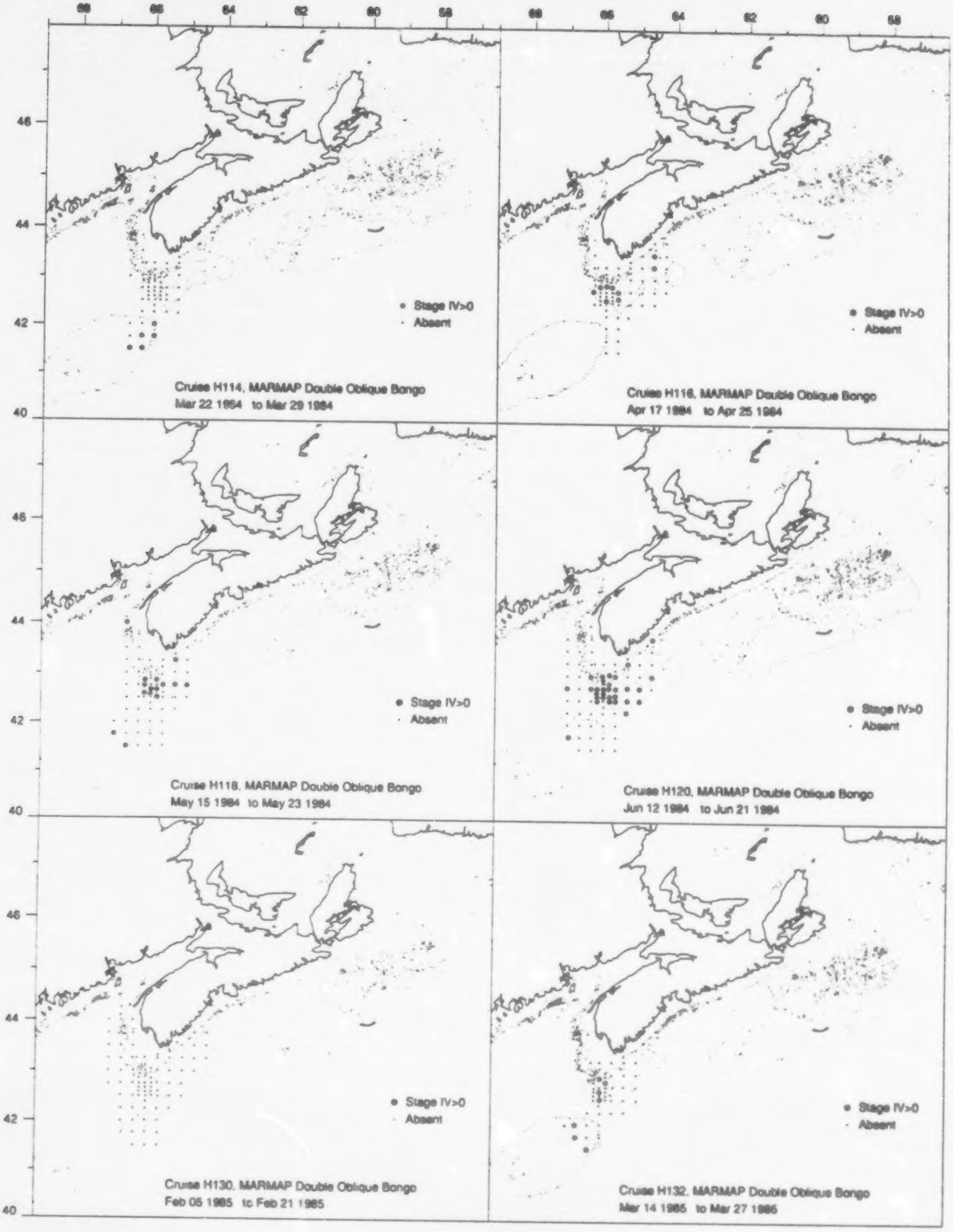

68
66
64
62
60
58
46
44
42
40
Stage IV>0
Absent
Cruise H091, MARMAP Double Oblique Bongo
Feb 08 1983 to Feb 17 1983
Cruise H093, MARMAP Double Oblique Bongo
Mar 08 1983 to Mar 16 1983
Cruise P269, MARMAP Double Oblique Bongo
Apr 07 1983 to Apr 20 1983
Cruise H097, MARMAP Double Oblique Bongo
May 04 1983 to May 13 1983
Cruise H098, MARMAP Double Oblique Bongo
Jun 04 1983 to Jun 12 1983
Cruise H112, MARMAP Double Oblique Bongo
Feb 08 1984 to Feb 22 1984

Fig. 8.3.5. Fisheries Ecology Program Cruises: Stage IV haddock eggs.



Cruise H114, MARMAP Double Oblique Bongo
Mar 22 1984 to Mar 29 1984

Cruise H116, MARMAP Double Oblique Bongo
Apr 17 1984 to Apr 25 1984

Cruise H118, MARMAP Double Oblique Bongo
May 15 1984 to May 23 1984

Cruise H120, MARMAP Double Oblique Bongo
Jun 12 1984 to Jun 21 1984

Cruise H130, MARMAP Double Oblique Bongo
Feb 06 1985 to Feb 21 1985

Cruise H132, MARMAP Double Oblique Bongo
Mar 14 1985 to Mar 27 1985

Fig. 8.3.5. (continued).

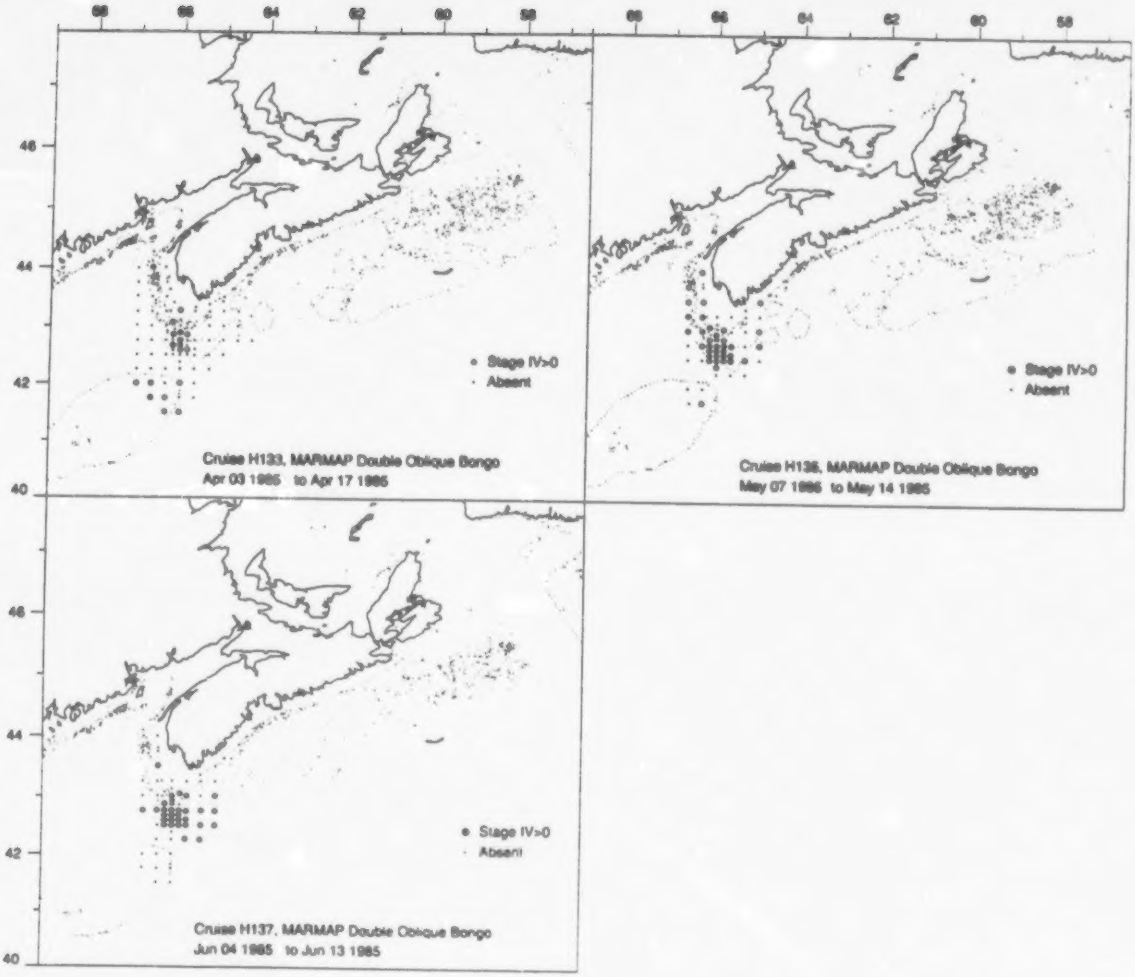

68
66
64
62
60
58
46
44
42
40
Stage IV>0
Absent
Cruise H133, MARMAP Double Oblique Bongo
Apr 03 1985 to Apr 17 1985
Cruise H136, MARMAP Double Oblique Bongo
May 07 1985 to May 14 1985
Cruise H137, MARMAP Double Oblique Bongo
Jun 04 1985 to Jun 13 1985

Fig. 8.3.5. (continued).

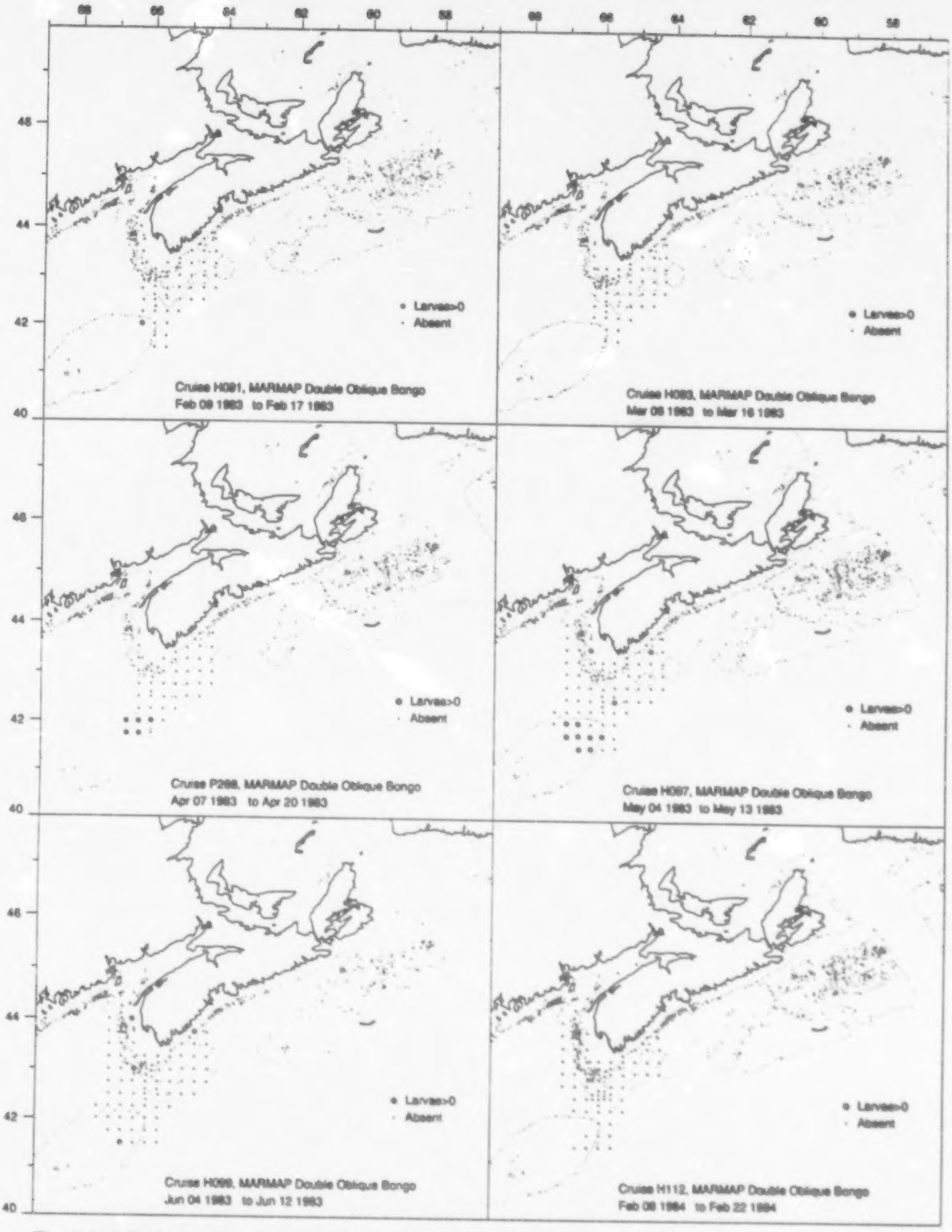

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
Larvae>0
Absent
Cruise H091, MARMAP Double Oblique Bongo
Feb 09 1983 to Feb 17 1983
Larvae>0
Absent
Cruise H093, MARMAP Double Oblique Bongo
Mar 06 1983 to Mar 16 1983
Larvae>0
Absent
Cruise P288, MARMAP Double Oblique Bongo
Apr 07 1983 to Apr 20 1983
Larvae>0
Absent
Cruise H097, MARMAP Double Oblique Bongo
May 04 1983 to May 13 1983
Larvae>0
Absent
Cruise H099, MARMAP Double Oblique Bongo
Jun 04 1983 to Jun 12 1983
Larvae>0
Absent
Cruise H112, MARMAP Double Oblique Bongo
Feb 08 1984 to Feb 22 1984

Fig. 8.3.6. Fisheries Ecology Program Cruises: Haddock larvae (1-7mm).

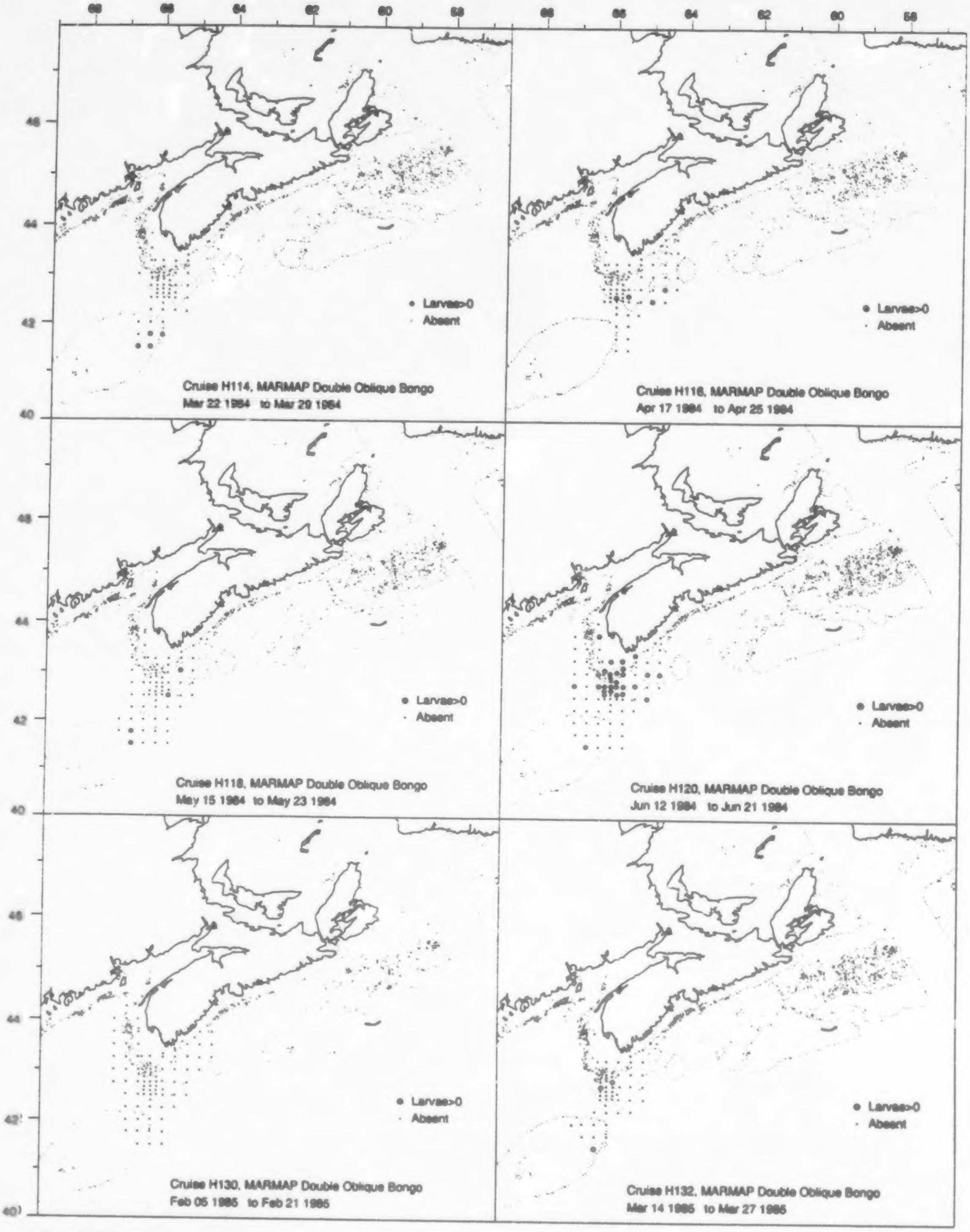

68
66
64
62
60
58
46
44
42
40
● Larvae>0
· Absent
Cruise H114, MARMAP Double Oblique Bongo
Mar 22 1984 to Mar 29 1984
Cruise H116, MARMAP Double Oblique Bongo
Apr 17 1984 to Apr 25 1984
Cruise H118, MARMAP Double Oblique Bongo
May 15 1984 to May 23 1984
Cruise H120, MARMAP Double Oblique Bongo
Jun 12 1984 to Jun 21 1984
Cruise H130, MARMAP Double Oblique Bongo
Feb 05 1985 to Feb 21 1985
Cruise H132, MARMAP Double Oblique Bongo
Mar 14 1985 to Mar 27 1985

Fig. 8.3.6. (continued).

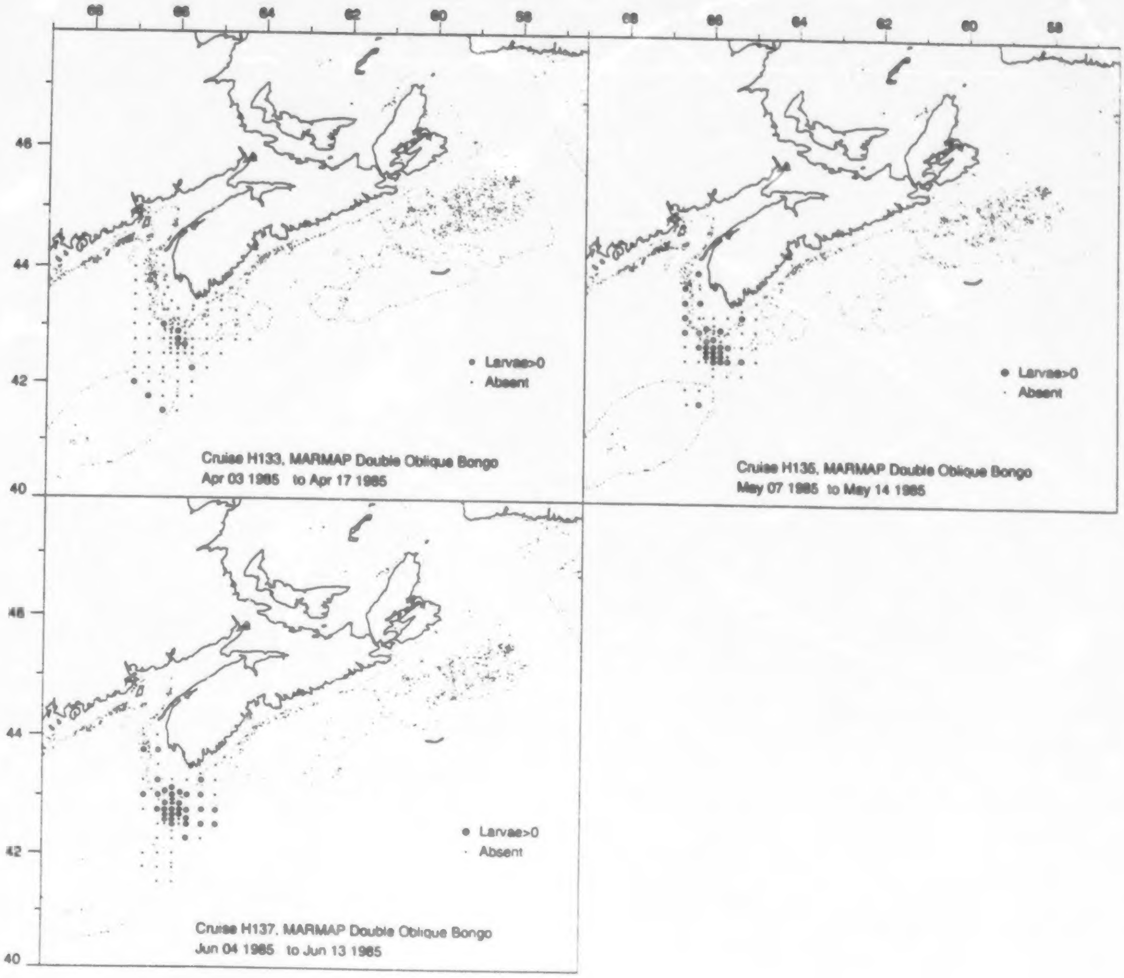

68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent
Cruise H133, MARMAP Double Oblique Bongo
Apr 03 1985 to Apr 17 1985
Cruise H135, MARMAP Double Oblique Bongo
May 07 1985 to May 14 1985
Cruise H137, MARMAP Double Oblique Bongo
Jun 04 1985 to Jun 13 1985

Fig. 8.3.6. (continued).

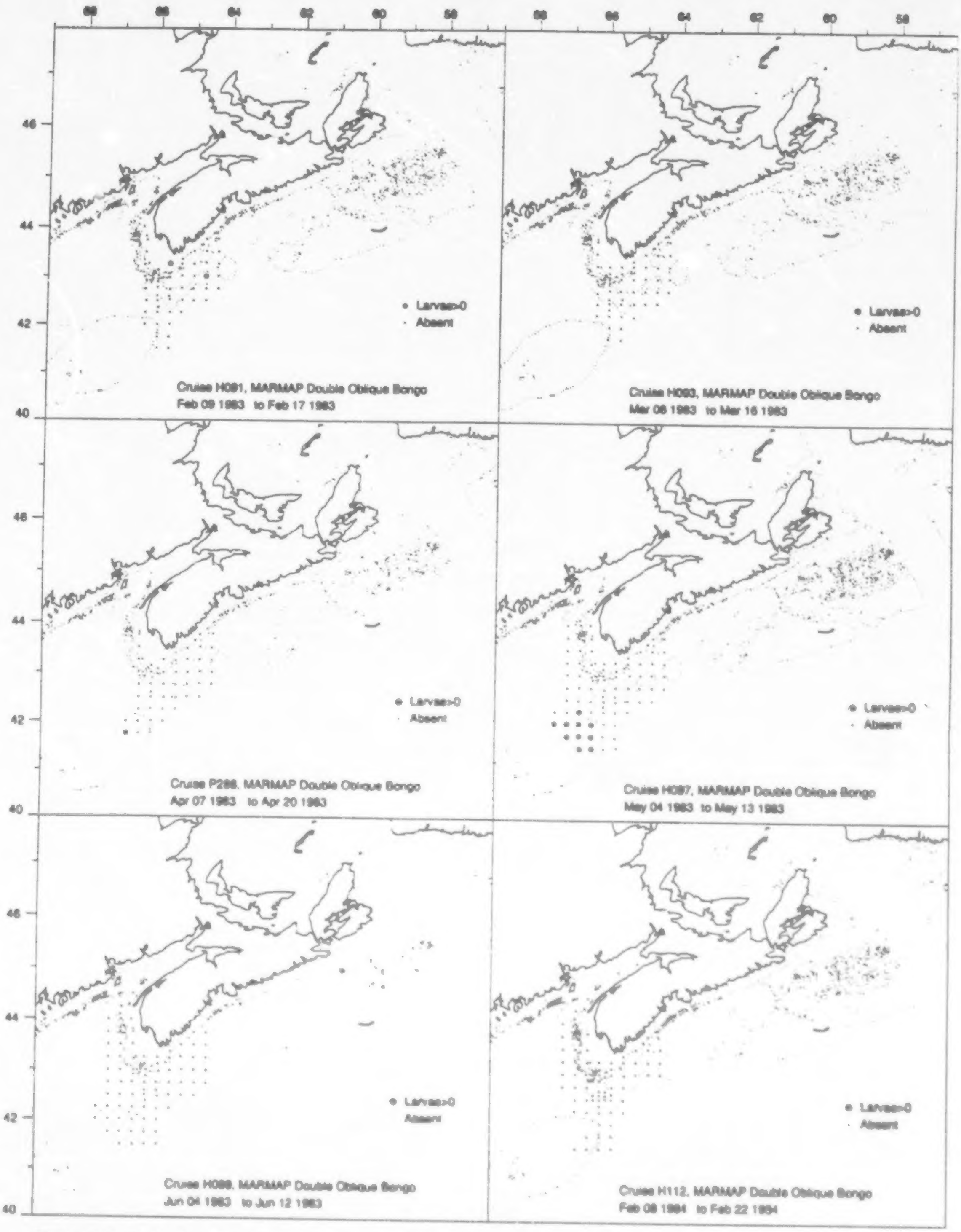
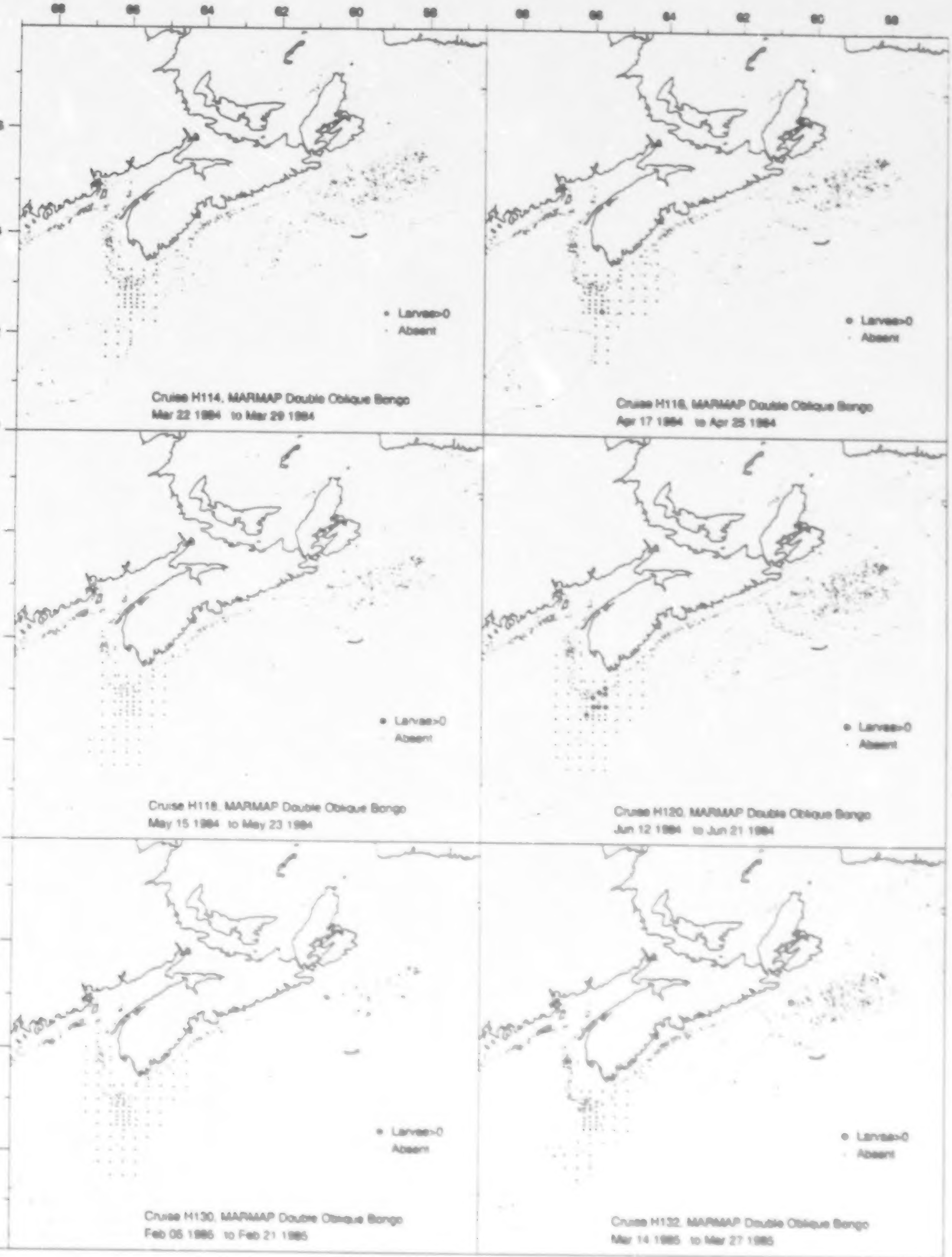

68
66
64
62
60
58
46
44
42
40
● Larvae>0
· Absent
Cruise H091, MARMAP Double Oblique Bongo
Feb 09 1983 to Feb 17 1983
Cruise H093, MARMAP Double Oblique Bongo
Mar 06 1983 to Mar 16 1983
Cruise P288, MARMAP Double Oblique Bongo
Apr 07 1983 to Apr 20 1983
Cruise H097, MARMAP Double Oblique Bongo
May 04 1983 to May 13 1983
Cruise H099, MARMAP Double Oblique Bongo
Jun 04 1983 to Jun 12 1983
Cruise H112, MARMAP Double Oblique Bongo
Feb 08 1984 to Feb 22 1984

Fig. 8.3.7. Fisheries Ecology Program Cruises: Haddock larvae (7+mm).


68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
● Larvae>0
· Absent

Cruise H114, MARMAP Double Oblique Bongo
Mar 22 1984 to Mar 29 1984

Cruise H116, MARMAP Double Oblique Bongo
Apr 17 1984 to Apr 25 1984

Cruise H118, MARMAP Double Oblique Bongo
May 15 1984 to May 23 1984

Cruise H120, MARMAP Double Oblique Bongo
Jun 12 1984 to Jun 21 1984

Cruise H130, MARMAP Double Oblique Bongo
Feb 05 1985 to Feb 21 1985

Cruise H132, MARMAP Double Oblique Bongo
Mar 14 1985 to Mar 27 1985

Fig. 8.3.7. (continued).

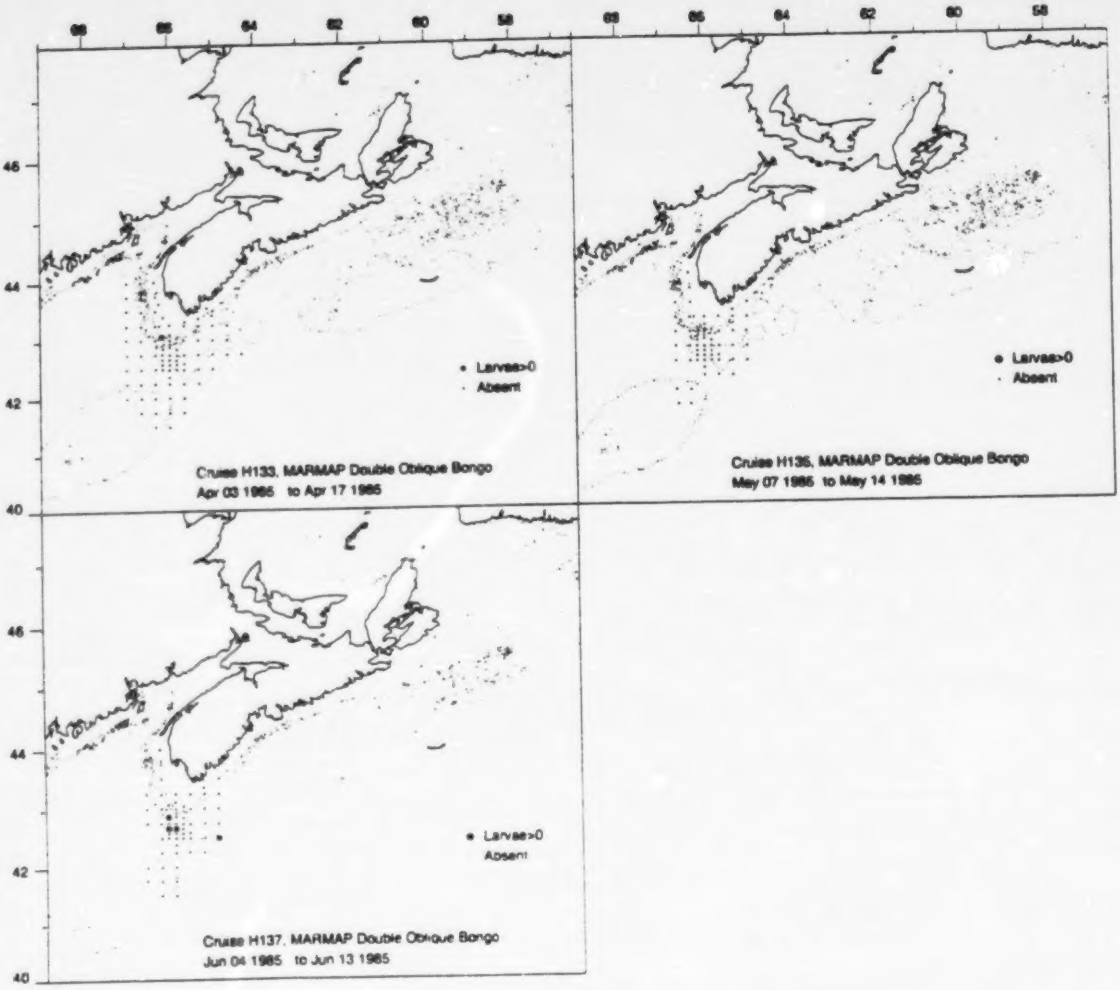

68
66
64
62
60
58
46
44
42
40
• Larvae>0
· Absent
Cruise H133, MARMAP Double Oblique Bongo
Apr 03 1985 to Apr 17 1985
Cruise H135, MARMAP Double Oblique Bongo
May 07 1985 to May 14 1985
Cruise H137, MARMAP Double Oblique Bongo
Jun 04 1985 to Jun 13 1985

Fig. 8.3.7. (continued).

F2

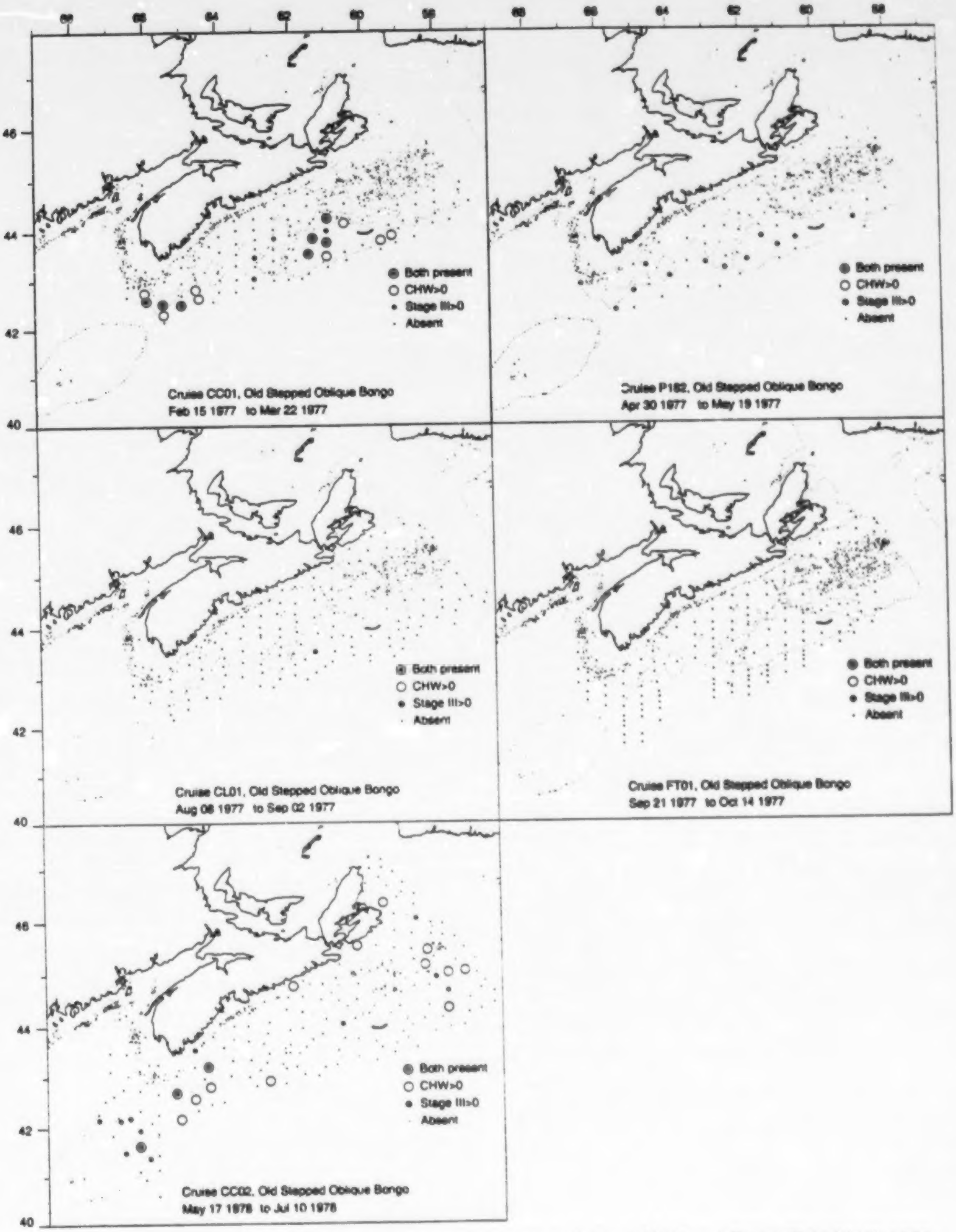
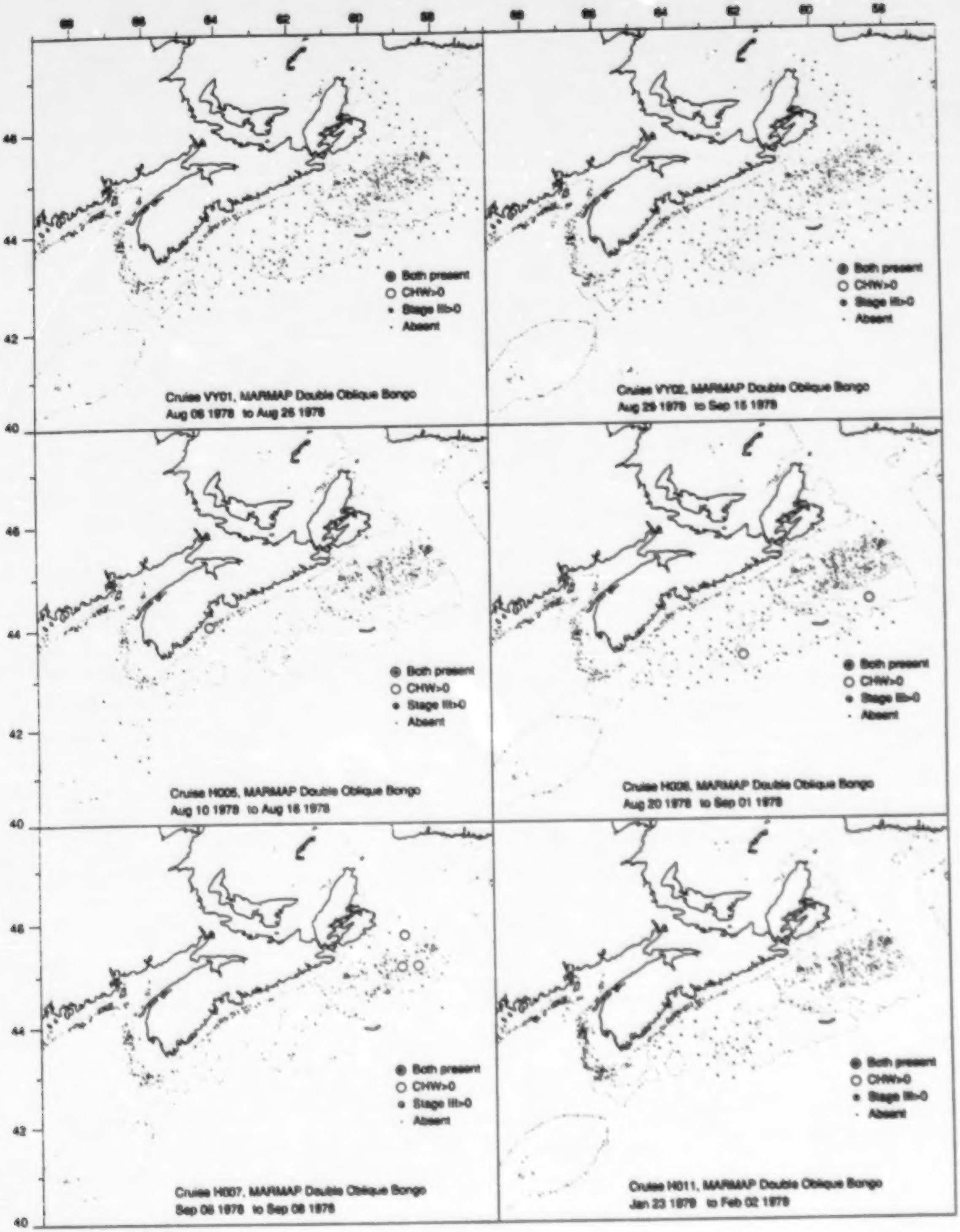

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise CC01, Old Stepped Oblique Bongo
Feb 15 1977 to Mar 22 1977
Cruise P182, Old Stepped Oblique Bongo
Apr 30 1977 to May 19 1977
Cruise CL01, Old Stepped Oblique Bongo
Aug 08 1977 to Sep 02 1977
Cruise FT01, Old Stepped Oblique Bongo
Sep 21 1977 to Oct 14 1977
Cruise CC02, Old Stepped Oblique Bongo
May 17 1978 to Jul 10 1978

Fig. 8.4.1. Scotian Shelf Ichthyoplankton Program Cruises: Stage I CHW and Stage III haddock eggs.


68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent

Cruise VY01, MARMAP Double Oblique Bongo
Aug 06 1978 to Aug 26 1978

Cruise VY02, MARMAP Double Oblique Bongo
Aug 29 1978 to Sep 15 1978

Cruise H005, MARMAP Double Oblique Bongo
Aug 10 1978 to Aug 16 1978

Cruise H006, MARMAP Double Oblique Bongo
Aug 20 1978 to Sep 01 1978

Cruise H007, MARMAP Double Oblique Bongo
Sep 06 1978 to Sep 08 1978

Cruise H011, MARMAP Double Oblique Bongo
Jan 23 1979 to Feb 02 1979

Fig. 8.4.1. (continued).

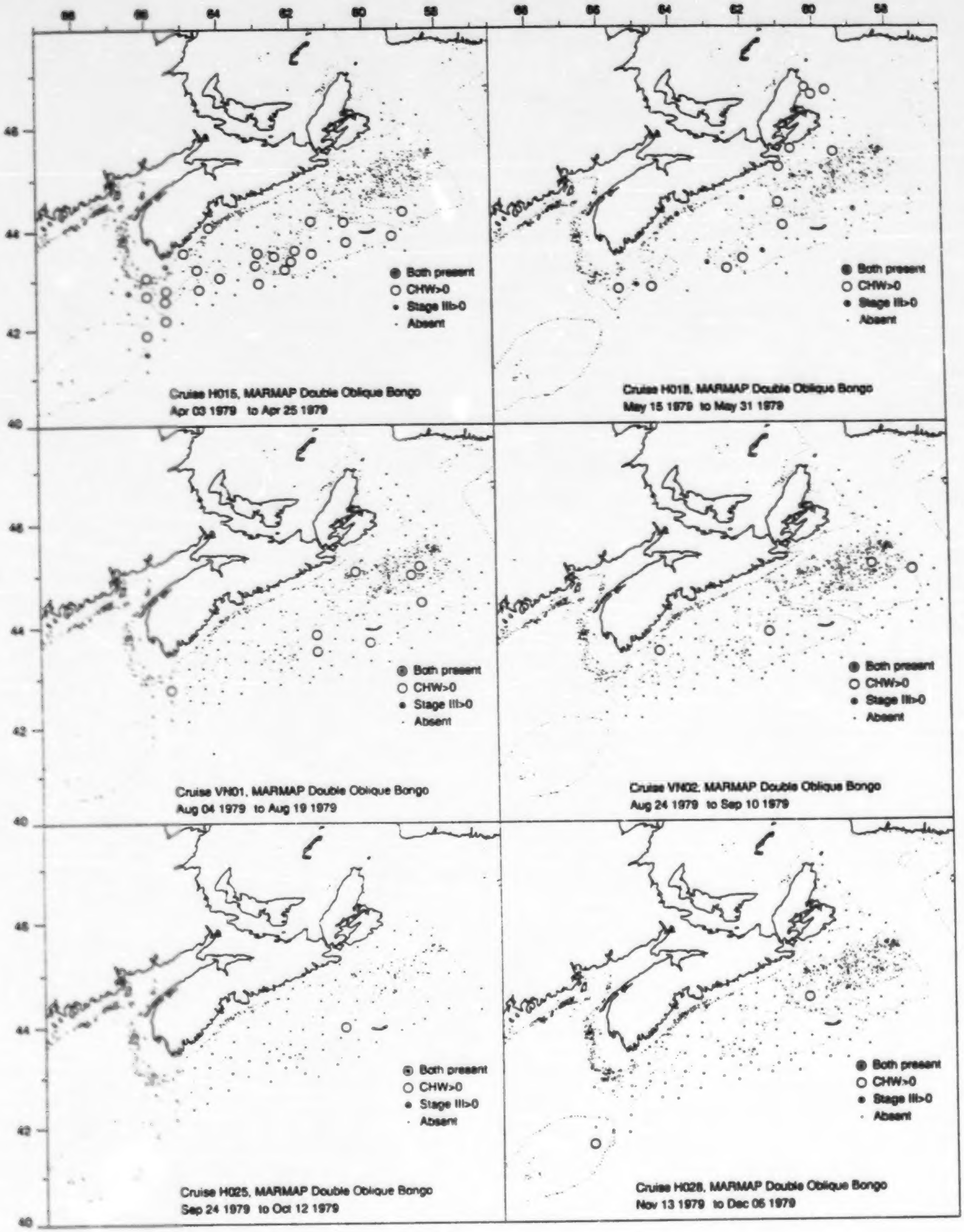

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H015, MARMAP Double Oblique Bongo
Apr 03 1979 to Apr 25 1979
Cruise H018, MARMAP Double Oblique Bongo
May 15 1979 to May 31 1979
Cruise VN01, MARMAP Double Oblique Bongo
Aug 04 1979 to Aug 19 1979
Cruise VN02, MARMAP Double Oblique Bongo
Aug 24 1979 to Sep 10 1979
Cruise H025, MARMAP Double Oblique Bongo
Sep 24 1979 to Oct 12 1979
Cruise H028, MARMAP Double Oblique Bongo
Nov 13 1979 to Dec 06 1979

Fig. 8.4.1. (continued).

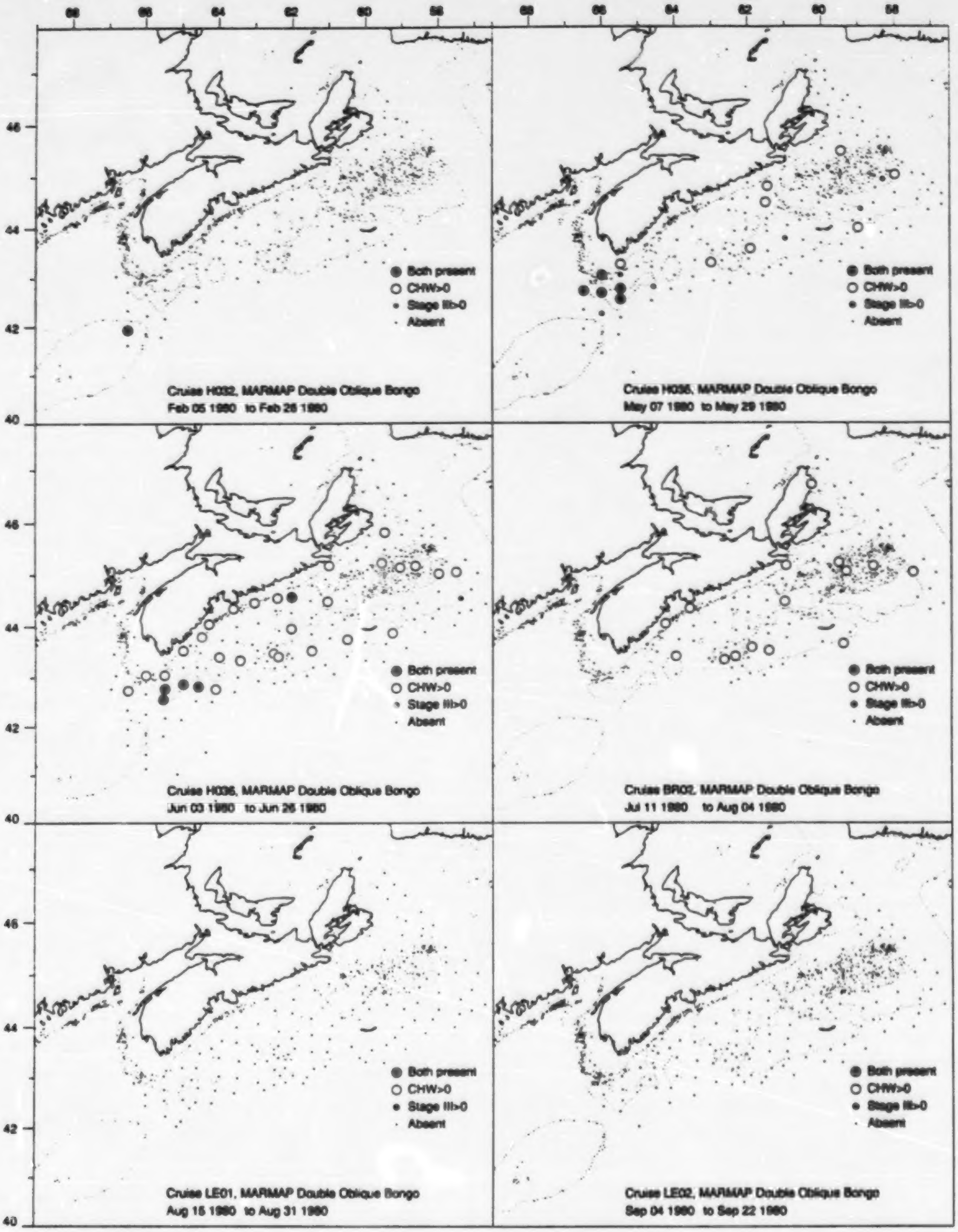
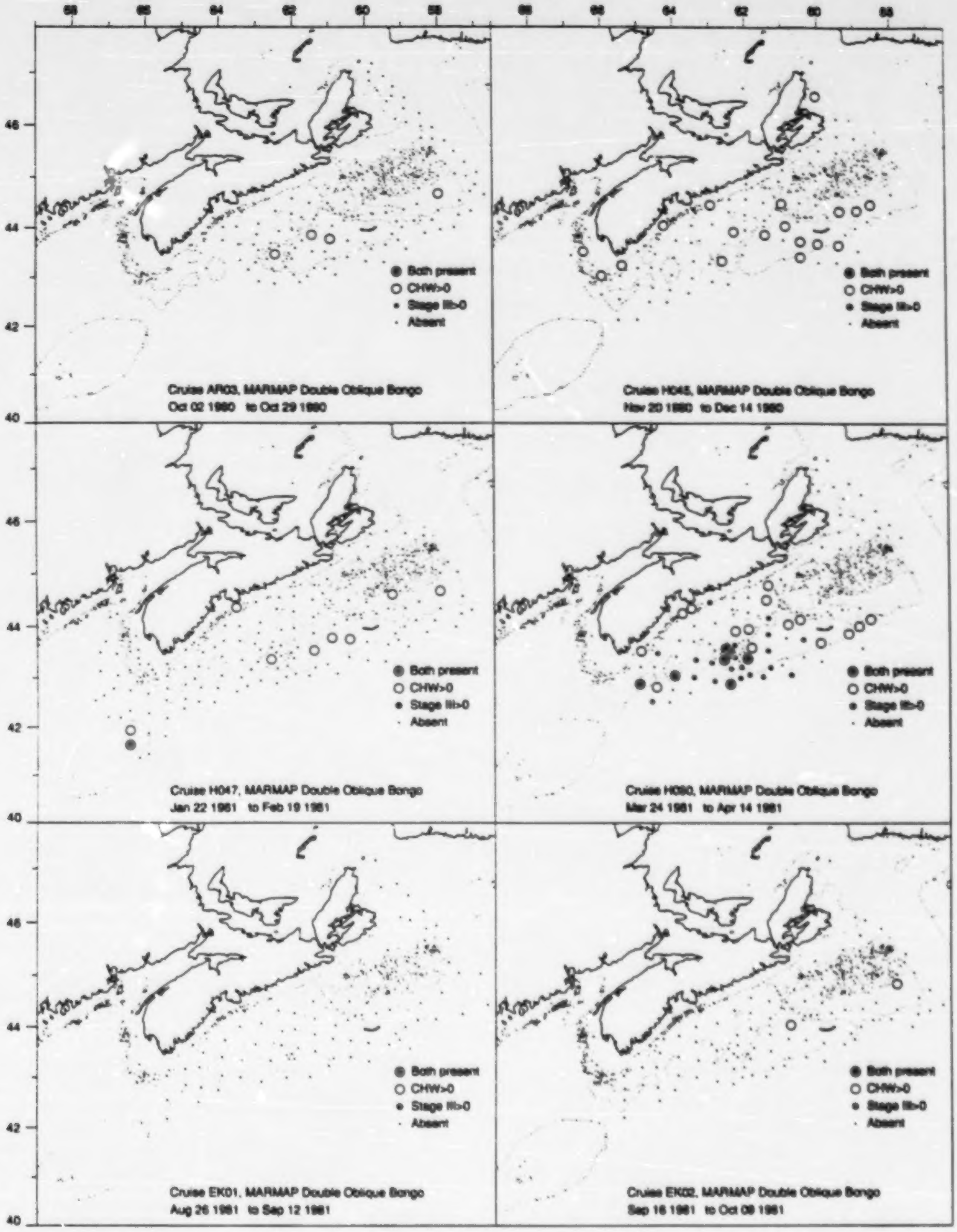

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise H032, MARMAP Double Oblique Bongo
Feb 05 1980 to Feb 26 1980
Cruise H035, MARMAP Double Oblique Bongo
May 07 1980 to May 29 1980
Cruise H036, MARMAP Double Oblique Bongo
Jun 03 1980 to Jun 26 1980
Cruise BR02, MARMAP Double Oblique Bongo
Jul 11 1980 to Aug 04 1980
Cruise LE01, MARMAP Double Oblique Bongo
Aug 15 1980 to Aug 31 1980
Cruise LE02, MARMAP Double Oblique Bongo
Sep 04 1980 to Sep 22 1980

Fig. 8.4.1. (continued).


68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent

Cruise AR03, MARMAP Double Oblique Bongo
Oct 02 1980 to Oct 29 1980

Cruise H045, MARMAP Double Oblique Bongo
Nov 20 1980 to Dec 14 1980

Cruise H047, MARMAP Double Oblique Bongo
Jan 22 1981 to Feb 19 1981

Cruise H050, MARMAP Double Oblique Bongo
Mar 24 1981 to Apr 14 1981

Cruise EK01, MARMAP Double Oblique Bongo
Aug 26 1981 to Sep 12 1981

Cruise EK02, MARMAP Double Oblique Bongo
Sep 16 1981 to Oct 09 1981

Fig. 8.4.1. (continued).

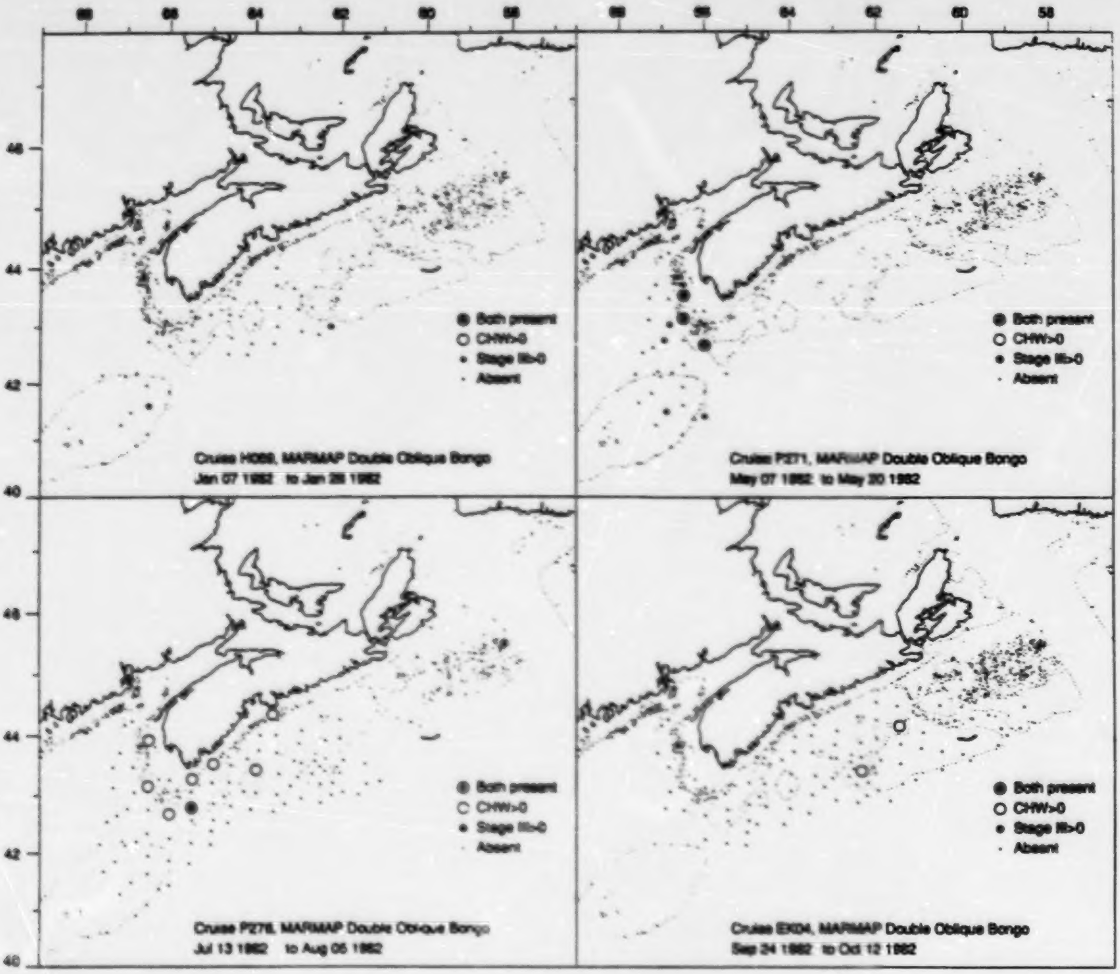

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H069, MARMAP Double Oblique Bongo
Jan 07 1982 to Jan 28 1982
Cruise P271, MARMAP Double Oblique Bongo
May 07 1982 to May 20 1982
Cruise P276, MARMAP Double Oblique Bongo
Jul 13 1982 to Aug 05 1982
Cruise EK04, MARMAP Double Oblique Bongo
Sep 24 1982 to Oct 12 1982

Fig. 8.4.1. (continued).

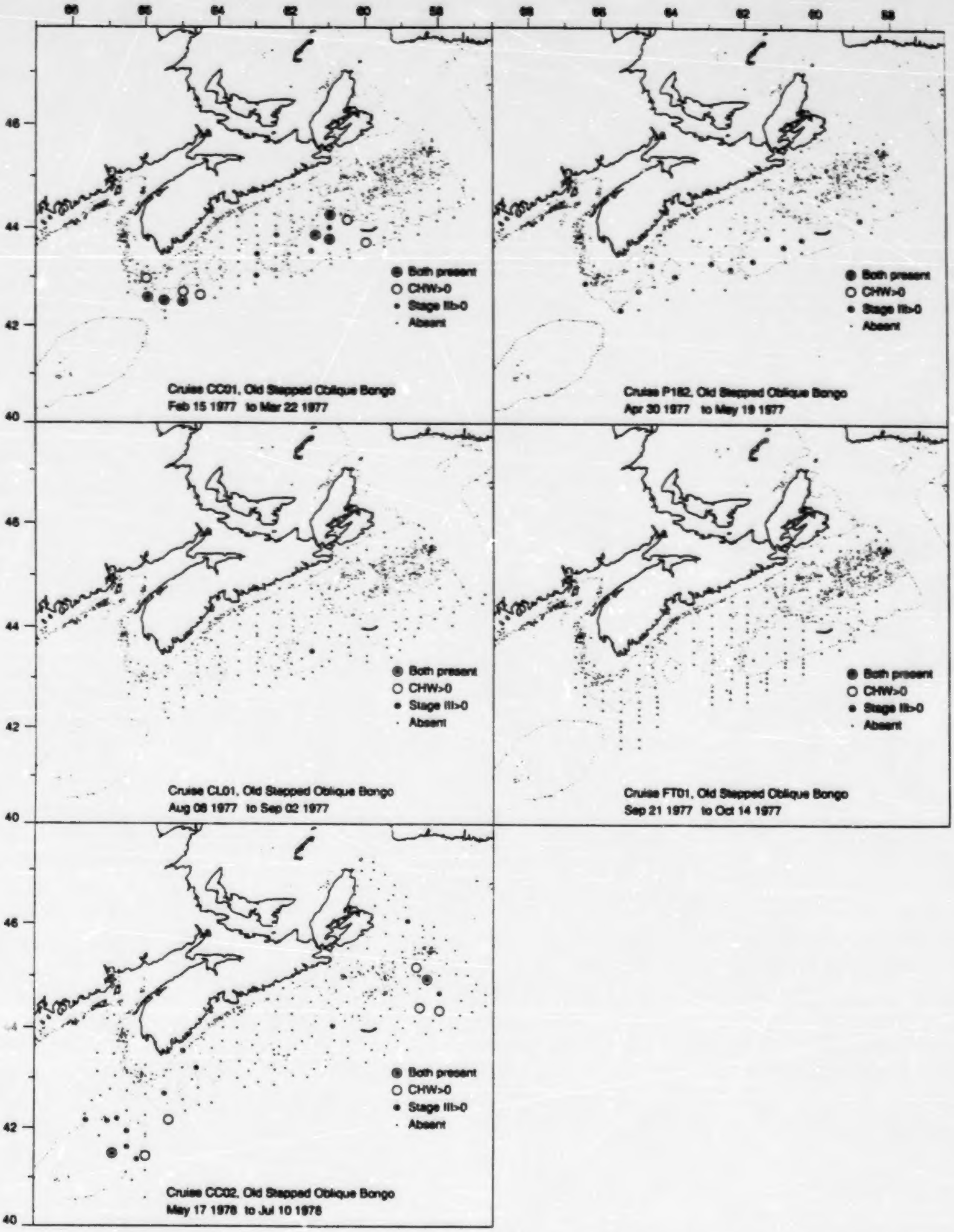

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise CC01, Old Stepped Oblique Bongo
Feb 15 1977 to Mar 22 1977
Cruise P182, Old Stepped Oblique Bongo
Apr 30 1977 to May 19 1977
Cruise CL01, Old Stepped Oblique Bongo
Aug 08 1977 to Sep 02 1977
Cruise FT01, Old Stepped Oblique Bongo
Sep 21 1977 to Oct 14 1977
Cruise CC02, Old Stepped Oblique Bongo
May 17 1978 to Jul 10 1978

Fig. 8.4.2. Scotian Shelf Ichthyoplankton Program Cruises: Stage II CHW and Stage III haddock eggs.

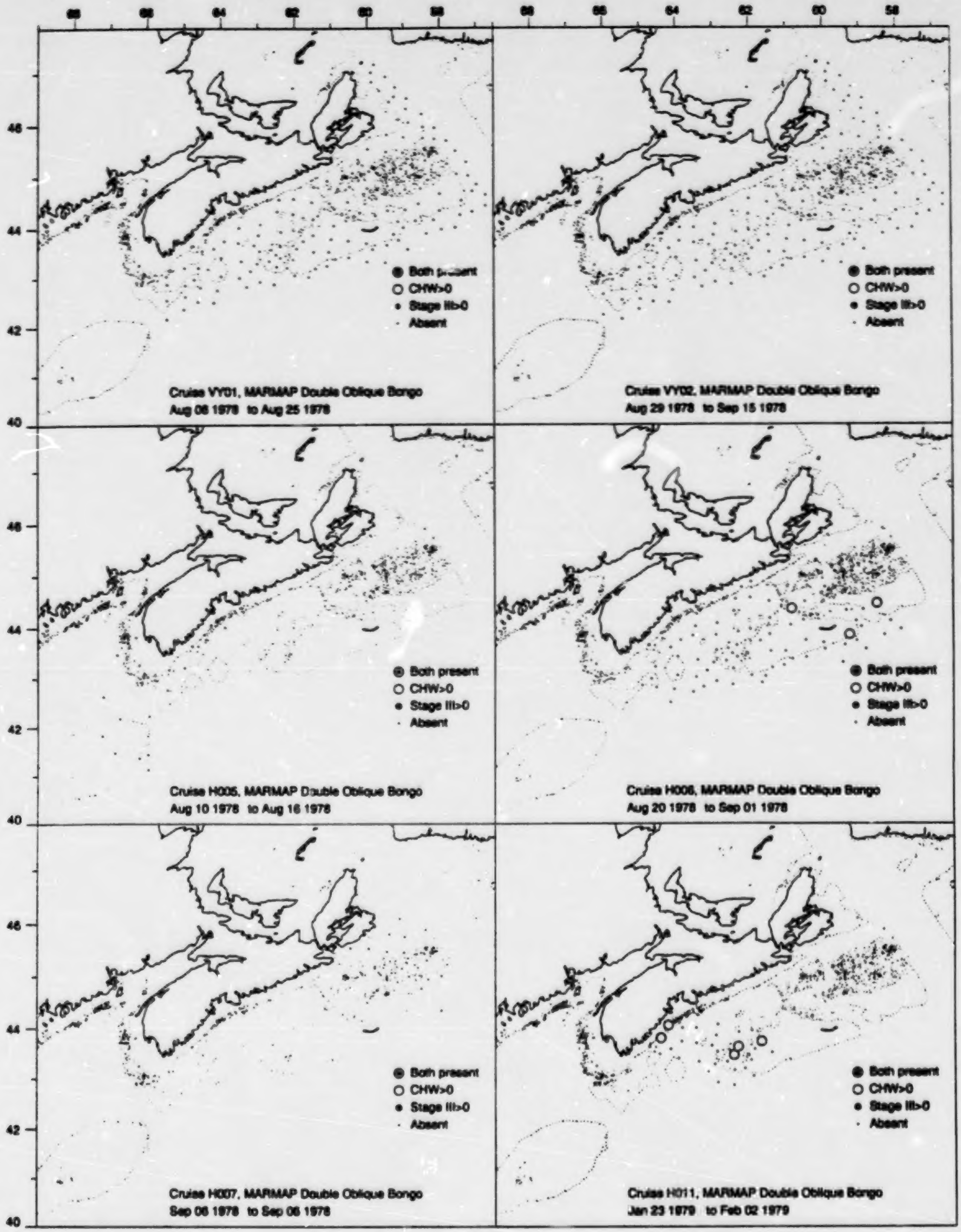
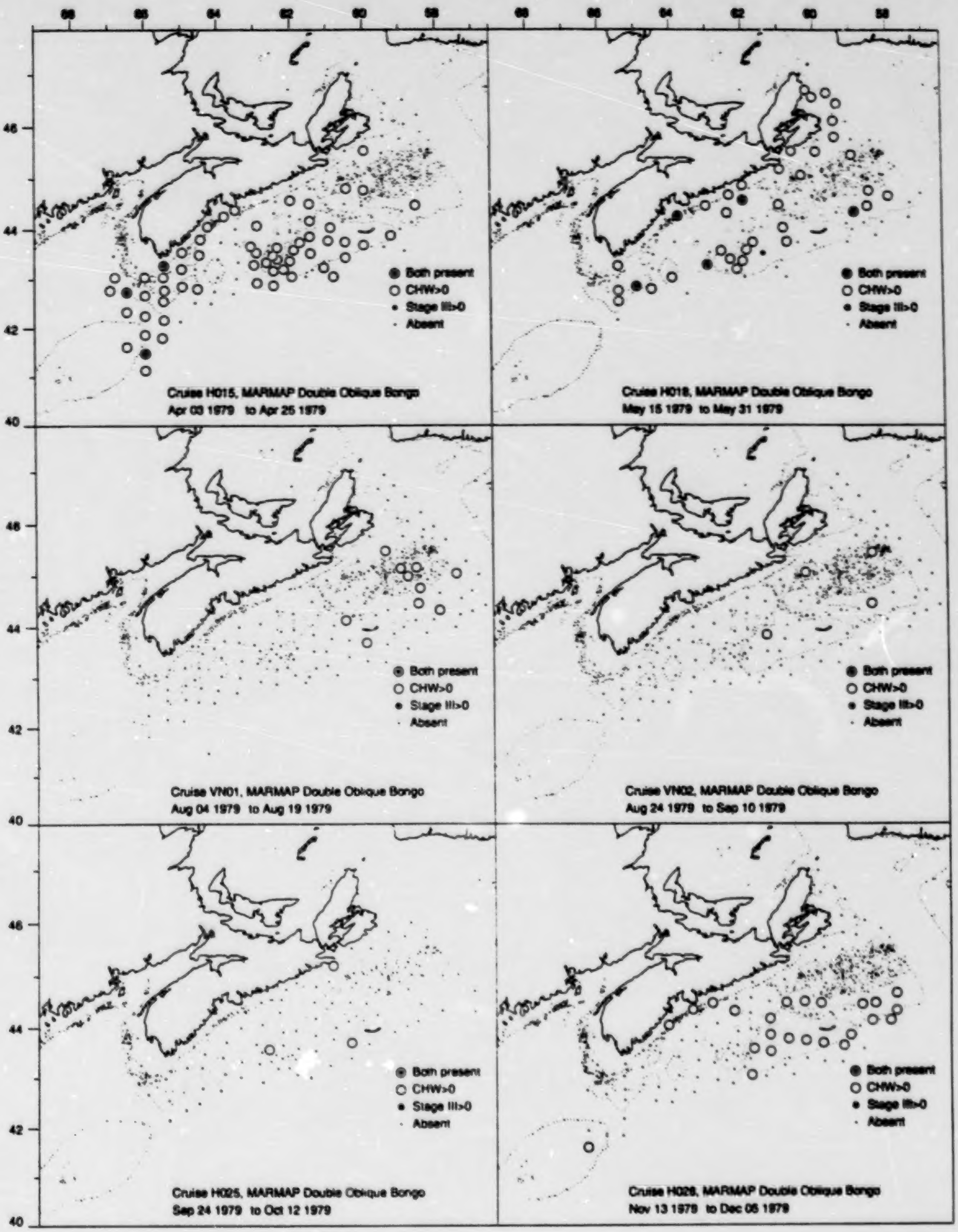

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise VY01, MARMAP Double Oblique Bongo
Aug 08 1978 to Aug 25 1978
Cruise VY02, MARMAP Double Oblique Bongo
Aug 29 1978 to Sep 15 1978
Cruise H005, MARMAP Double Oblique Bongo
Aug 10 1978 to Aug 16 1978
Cruise H006, MARMAP Double Oblique Bongo
Aug 20 1978 to Sep 01 1978
Cruise H007, MARMAP Double Oblique Bongo
Sep 06 1978 to Sep 06 1978
Cruise H011, MARMAP Double Oblique Bongo
Jan 23 1979 to Feb 02 1979

Fig. 8.4.2. (continued).


68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent

Cruise H015, MARMAP Double Oblique Bongo
Apr 03 1979 to Apr 25 1979

Cruise H018, MARMAP Double Oblique Bongo
May 15 1979 to May 31 1979

Cruise VN01, MARMAP Double Oblique Bongo
Aug 04 1979 to Aug 19 1979

Cruise VN02, MARMAP Double Oblique Bongo
Aug 24 1979 to Sep 10 1979

Cruise H025, MARMAP Double Oblique Bongo
Sep 24 1979 to Oct 12 1979

Cruise H028, MARMAP Double Oblique Bongo
Nov 13 1979 to Dec 05 1979

Fig. 8.4.2. (continued).

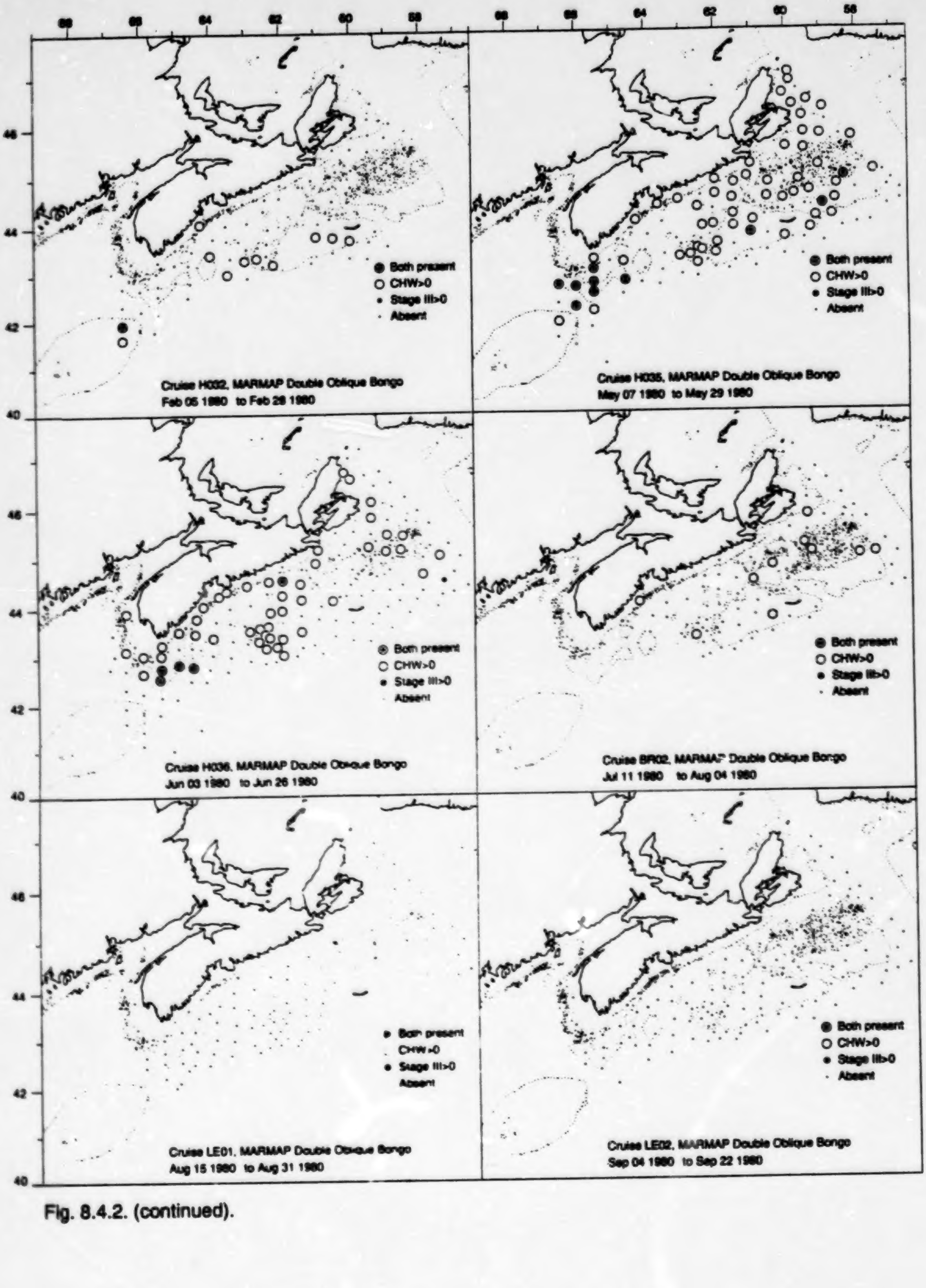

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H032, MARMAP Double Oblique Bongo
Feb 05 1980 to Feb 28 1980
Cruise H035, MARMAP Double Oblique Bongo
May 07 1980 to May 29 1980
Cruise H036, MARMAP Double Oblique Bongo
Jun 03 1980 to Jun 26 1980
Cruise BR02, MARMAP Double Oblique Bongo
Jul 11 1980 to Aug 04 1980
Cruise LE01, MARMAP Double Oblique Bongo
Aug 15 1980 to Aug 31 1980
Cruise LE02, MARMAP Double Oblique Bongo
Sep 04 1980 to Sep 22 1980

Fig. 8.4.2. (continued).

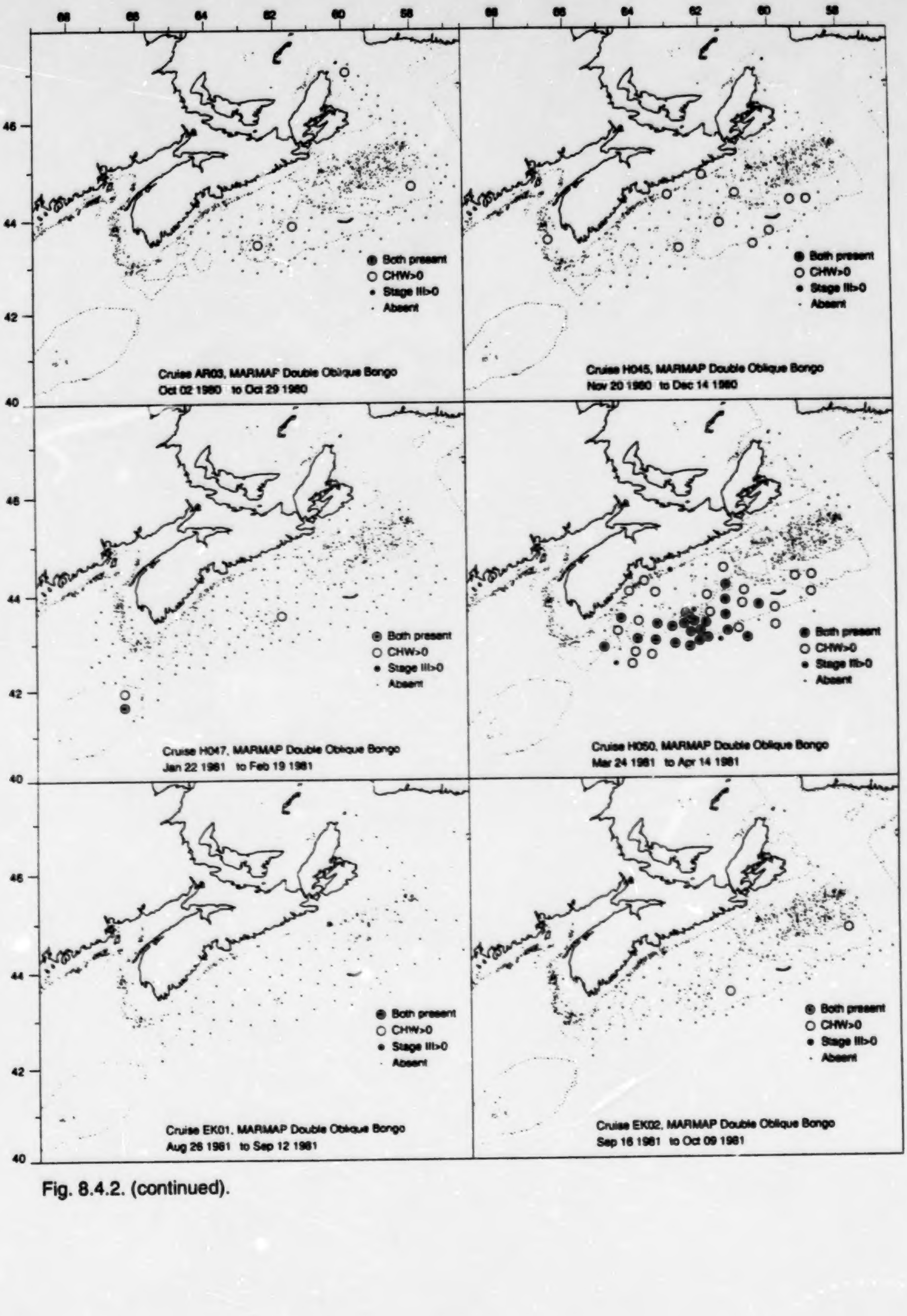

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise AR03, MARMAP Double Oblique Bongo
Oct 02 1980 to Oct 29 1980
Cruise H045, MARMAP Double Oblique Bongo
Nov 20 1980 to Dec 14 1980
Cruise H047, MARMAP Double Oblique Bongo
Jan 22 1981 to Feb 19 1981
Cruise H050, MARMAP Double Oblique Bongo
Mar 24 1981 to Apr 14 1981
Cruise EK01, MARMAP Double Oblique Bongo
Aug 26 1981 to Sep 12 1981
Cruise EK02, MARMAP Double Oblique Bongo
Sep 16 1981 to Oct 09 1981

Fig. 8.4.2. (continued).

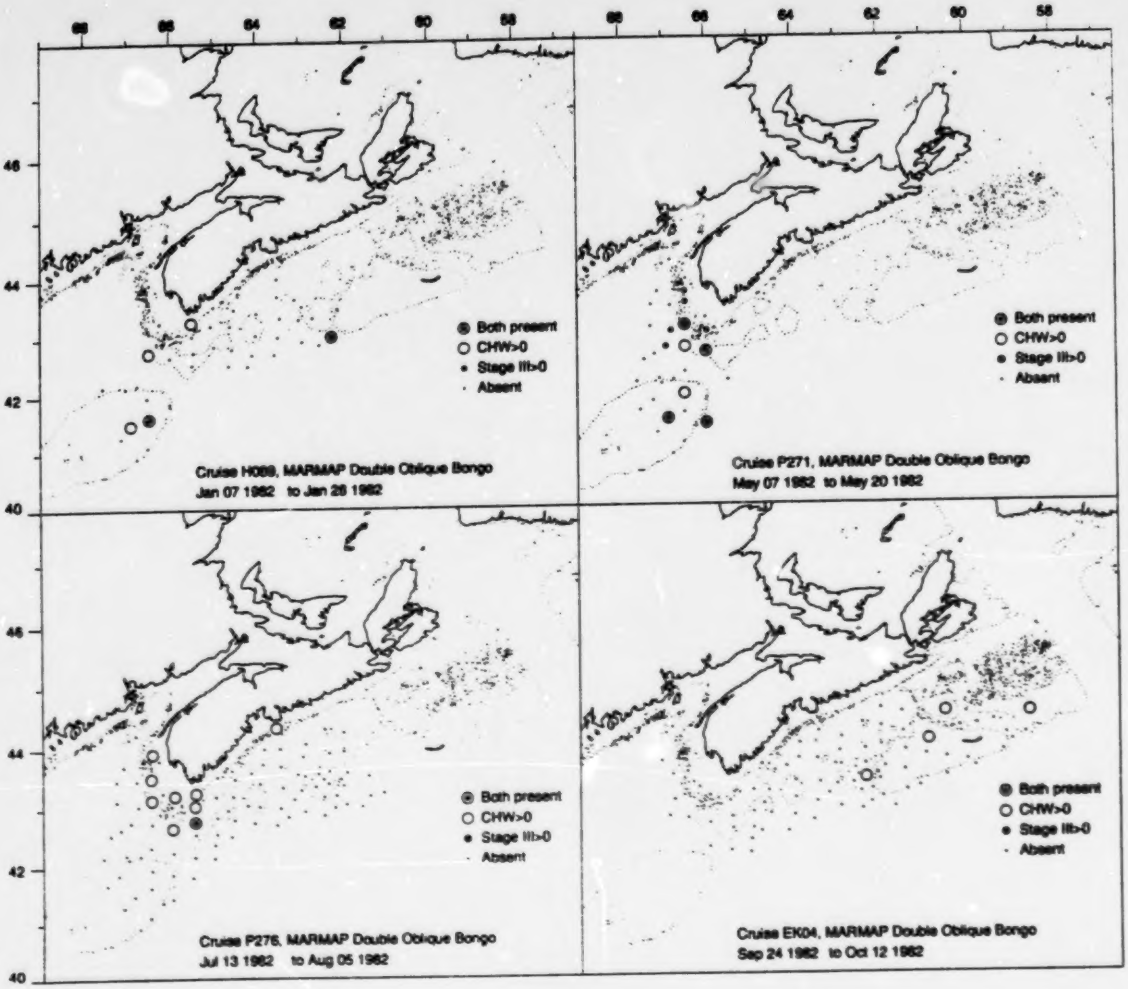
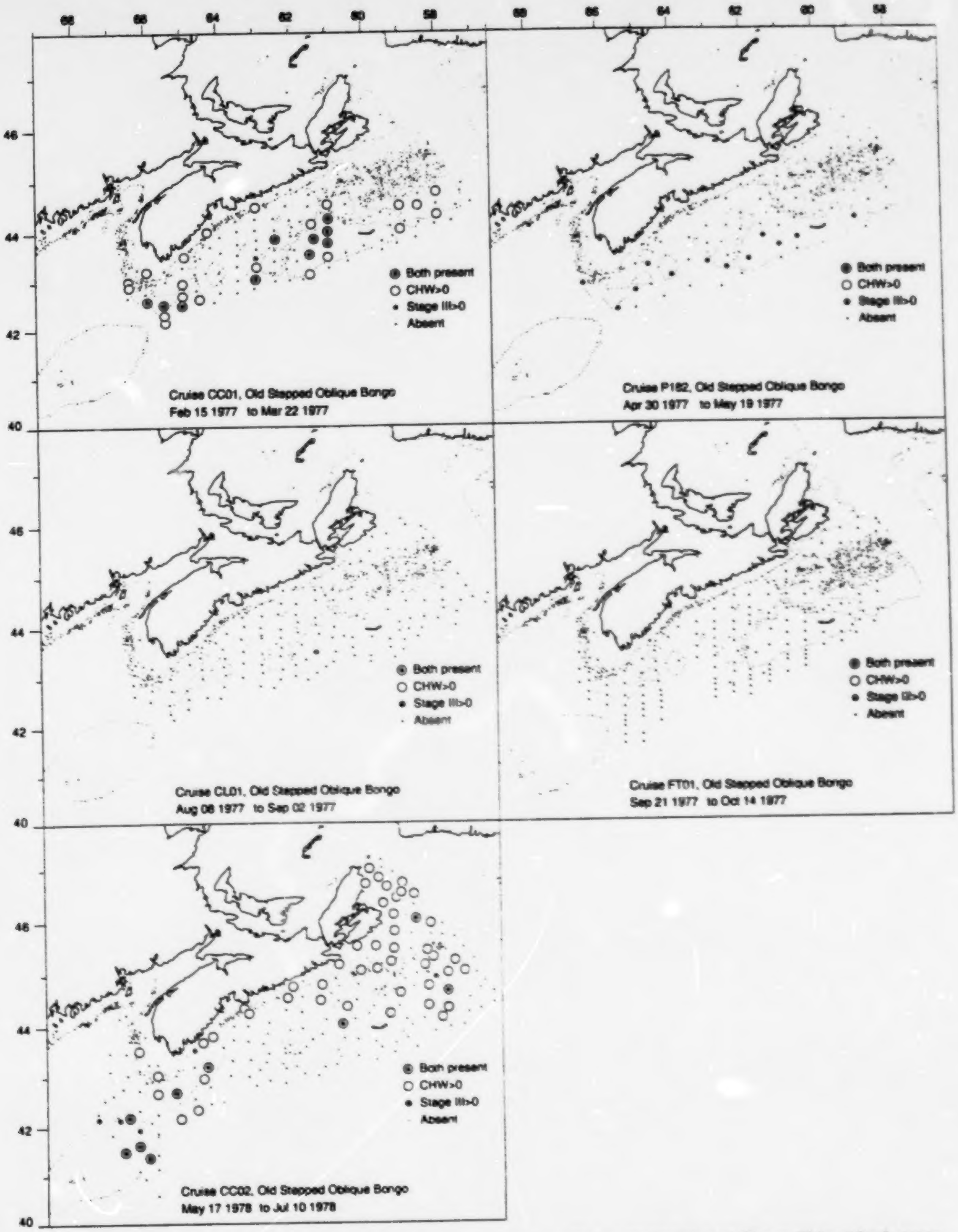

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H069, MARMAP Double Oblique Bongo
Jan 07 1982 to Jan 28 1982
Cruise P271, MARMAP Double Oblique Bongo
May 07 1982 to May 20 1982
Cruise P276, MARMAP Double Oblique Bongo
Jul 13 1982 to Aug 05 1982
Cruise EK04, MARMAP Double Oblique Bongo
Sep 24 1982 to Oct 12 1982

Fig. 8.4.2. (continued).


68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent

Cruise CC01, Old Stepped Oblique Bongo
Feb 15 1977 to Mar 22 1977

Cruise P182, Old Stepped Oblique Bongo
Apr 30 1977 to May 19 1977

Cruise CL01, Old Stepped Oblique Bongo
Aug 08 1977 to Sep 02 1977

Cruise FT01, Old Stepped Oblique Bongo
Sep 21 1977 to Oct 14 1977

Cruise CC02, Old Stepped Oblique Bongo
May 17 1978 to Jul 10 1978

Fig. 8.4.3. Scotian Shelf Ichthyoplankton Program Cruises: Stage III CHW and Stage III haddock eggs.

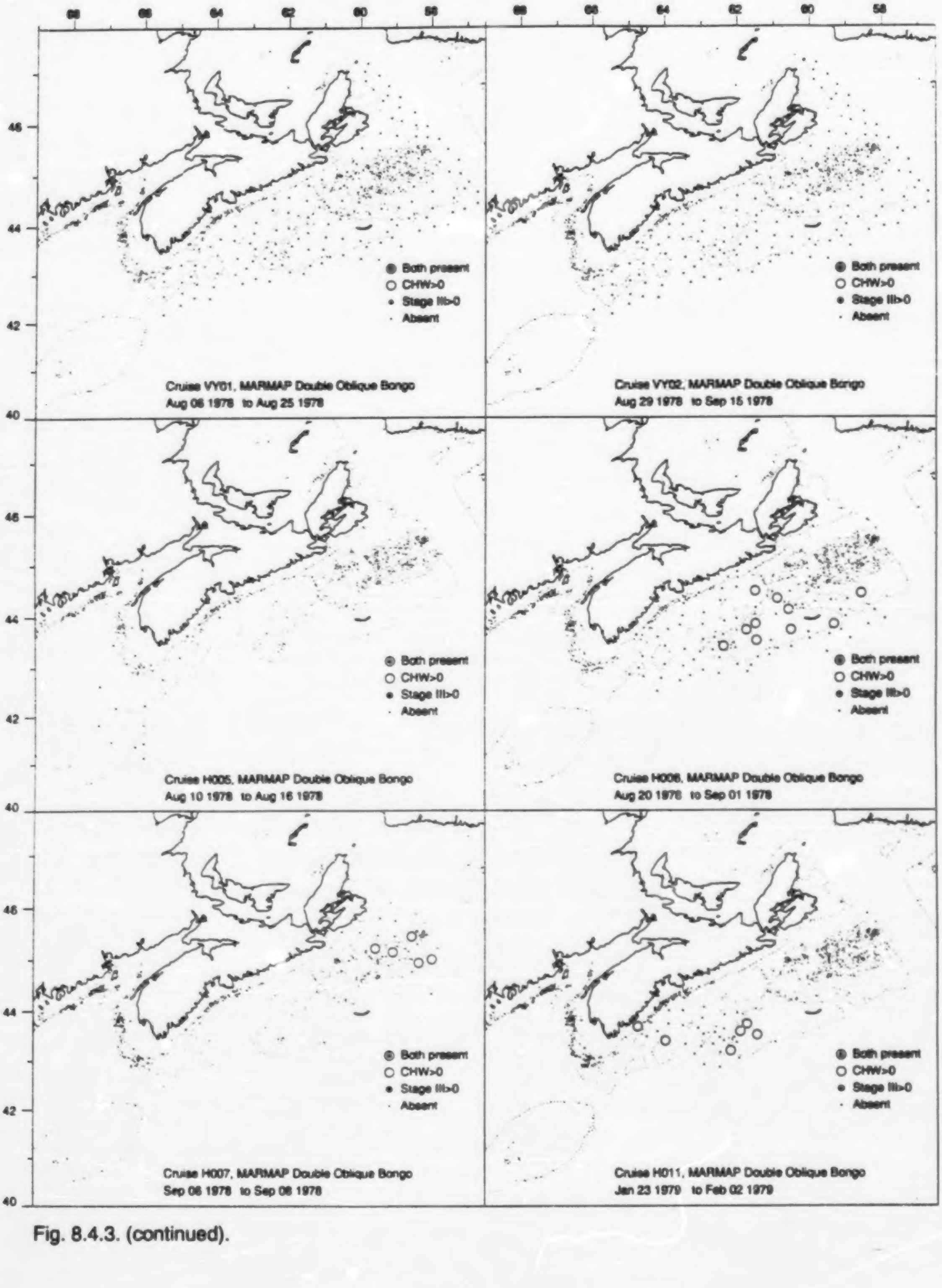
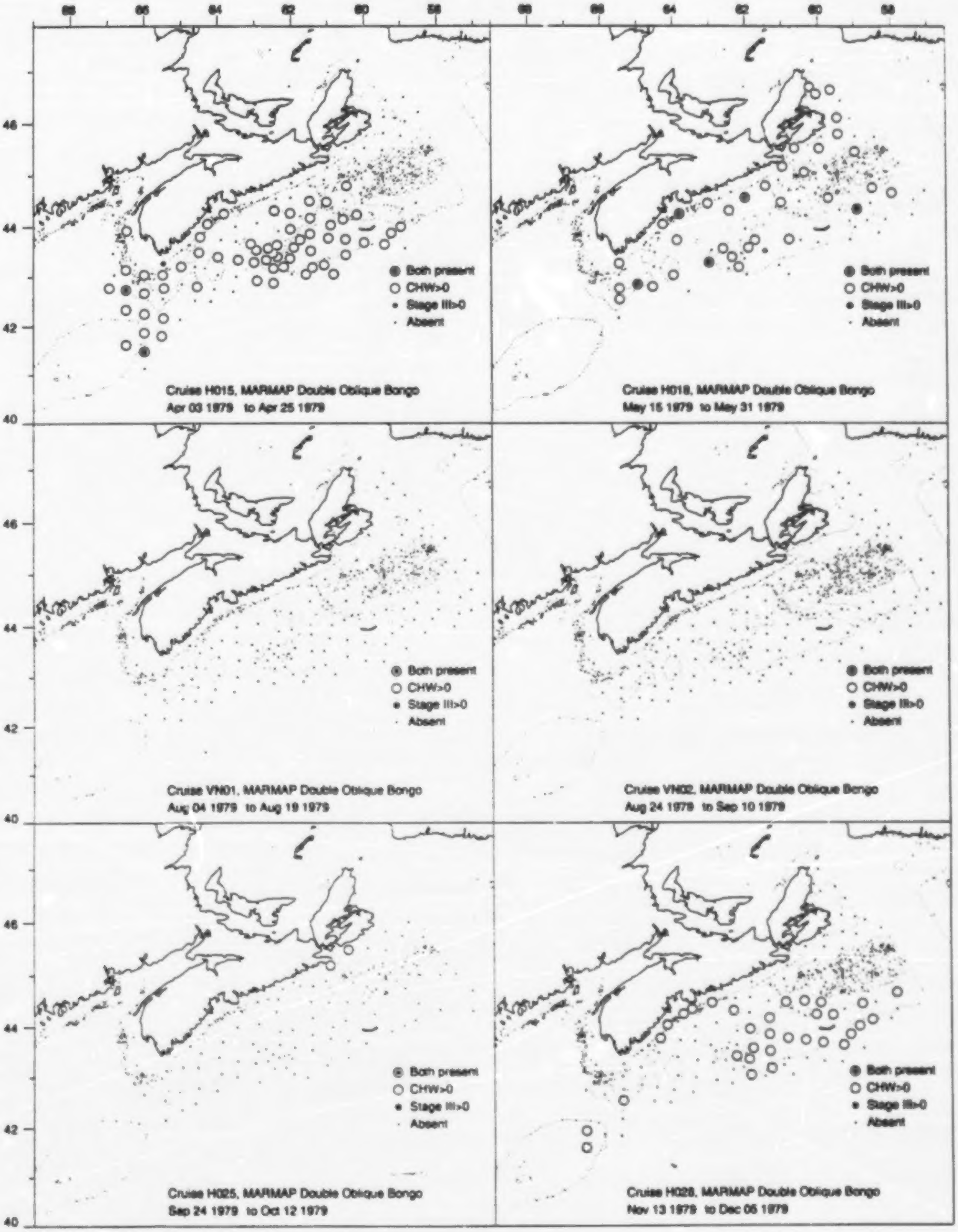

68
66
64
62
60
58
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise VY01, MARMAP Double Oblique Bongo
Aug 06 1978 to Aug 25 1978
Cruise VY02, MARMAP Double Oblique Bongo
Aug 29 1978 to Sep 15 1978
Cruise H005, MARMAP Double Oblique Bongo
Aug 10 1978 to Aug 16 1978
Cruise H006, MARMAP Double Oblique Bongo
Aug 20 1978 to Sep 01 1978
Cruise H007, MARMAP Double Oblique Bongo
Sep 06 1978 to Sep 08 1978
Cruise H011, MARMAP Double Oblique Bongo
Jan 23 1979 to Feb 02 1979

Fig. 8.4.3. (continued).


68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent

Cruise H015, MARMAP Double Oblique Bongo
Apr 03 1979 to Apr 25 1979

Cruise H018, MARMAP Double Oblique Bongo
May 15 1979 to May 31 1979

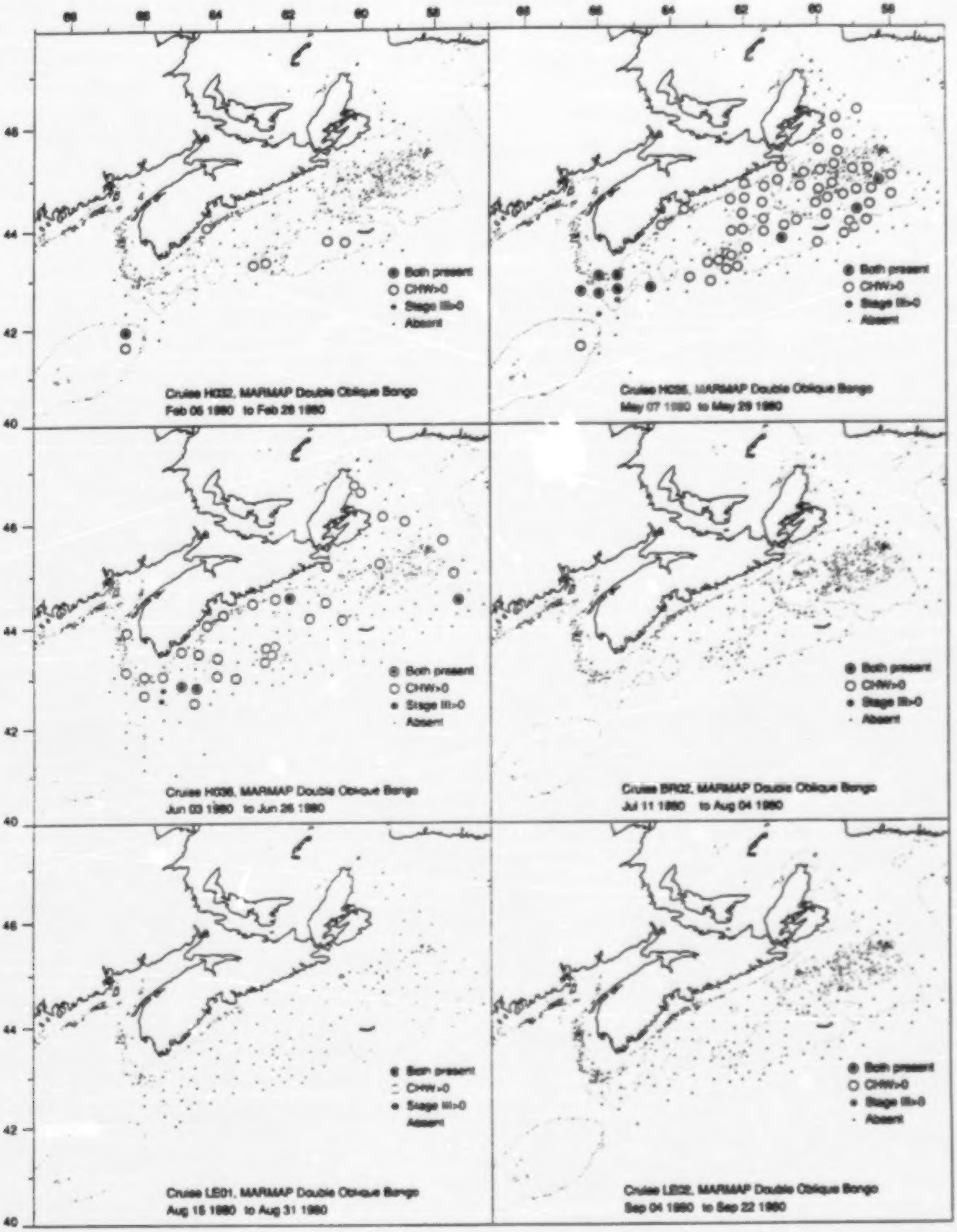
Cruise VN01, MARMAP Double Oblique Bongo
Aug 04 1979 to Aug 19 1979

Cruise VN02, MARMAP Double Oblique Bongo
Aug 24 1979 to Sep 10 1979

Cruise H025, MARMAP Double Oblique Bongo
Sep 24 1979 to Oct 12 1979

Cruise H028, MARMAP Double Oblique Bongo
Nov 13 1979 to Dec 06 1979

Fig. 8.4.3. (continued).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62
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58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
Both present
CHW>0
Stage III>0
Absent
Cruise H032, MARMAP Double Oblique Bongo
Feb 05 1980 to Feb 26 1980
Both present
CHW>0
Stage III>0
Absent
Cruise H035, MARMAP Double Oblique Bongo
May 07 1980 to May 29 1980
Both present
CHW>0
Stage III>0
Absent
Cruise H036, MARMAP Double Oblique Bongo
Jun 03 1980 to Jun 26 1980
Both present
CHW>0
Stage III>0
Absent
Cruise BR02, MARMAP Double Oblique Bongo
Jul 11 1980 to Aug 04 1980
Both present
CHW>0
Stage III>0
Absent
Cruise LE01, MARMAP Double Oblique Bongo
Aug 15 1980 to Aug 31 1980
Both present
CHW>0
Stage III>0
Absent
Cruise LE02, MARMAP Double Oblique Bongo
Sep 04 1980 to Sep 22 1980

Fig. 8.4.3. (continued).

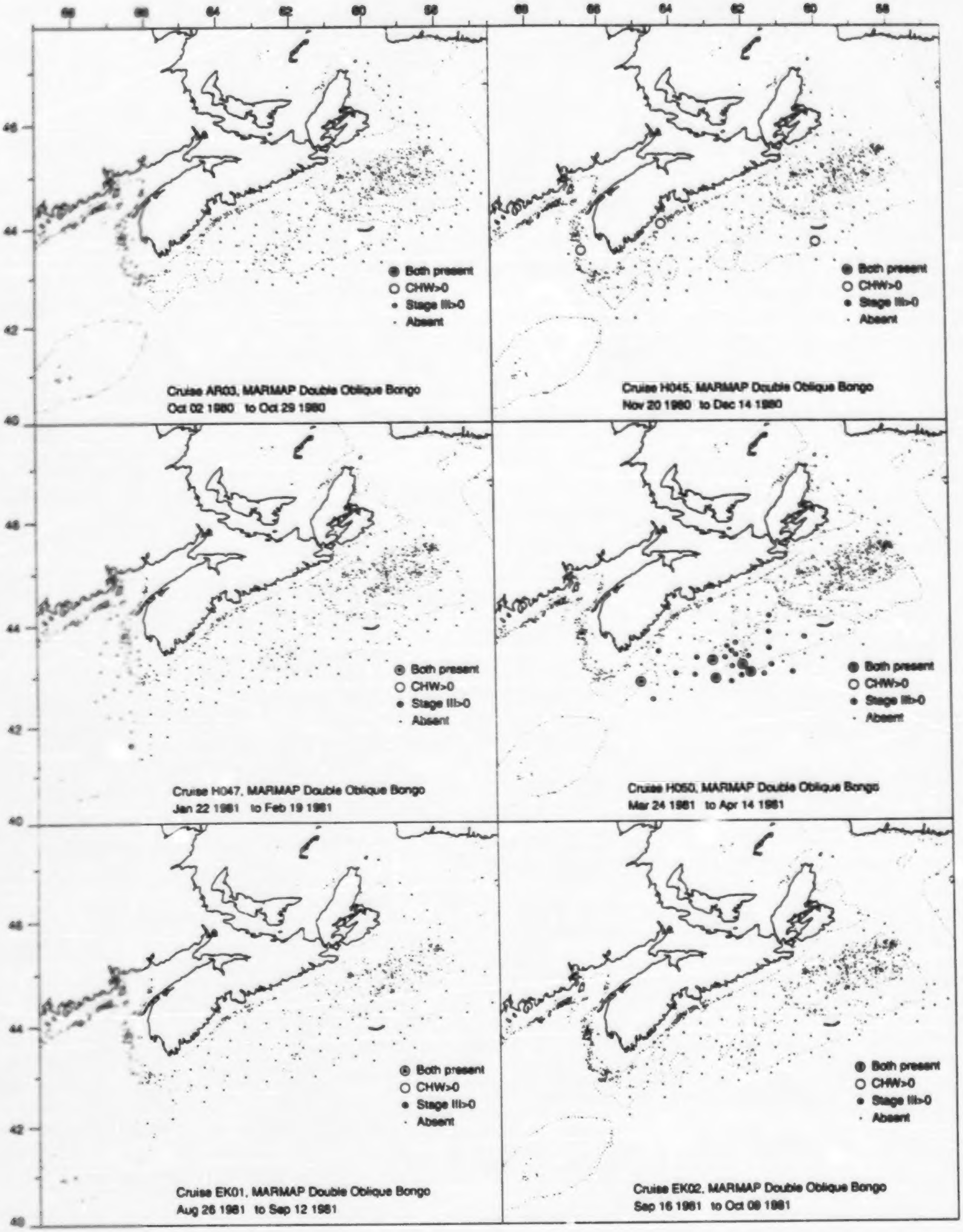

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise AR03, MARMAP Double Oblique Bongo
Oct 02 1980 to Oct 29 1980
Cruise H045, MARMAP Double Oblique Bongo
Nov 20 1980 to Dec 14 1980
Cruise H047, MARMAP Double Oblique Bongo
Jan 22 1981 to Feb 19 1981
Cruise H050, MARMAP Double Oblique Bongo
Mar 24 1981 to Apr 14 1981
Cruise EK01, MARMAP Double Oblique Bongo
Aug 26 1981 to Sep 12 1981
Cruise EK02, MARMAP Double Oblique Bongo
Sep 16 1981 to Oct 09 1981

Fig. 8.4.3. (continued).

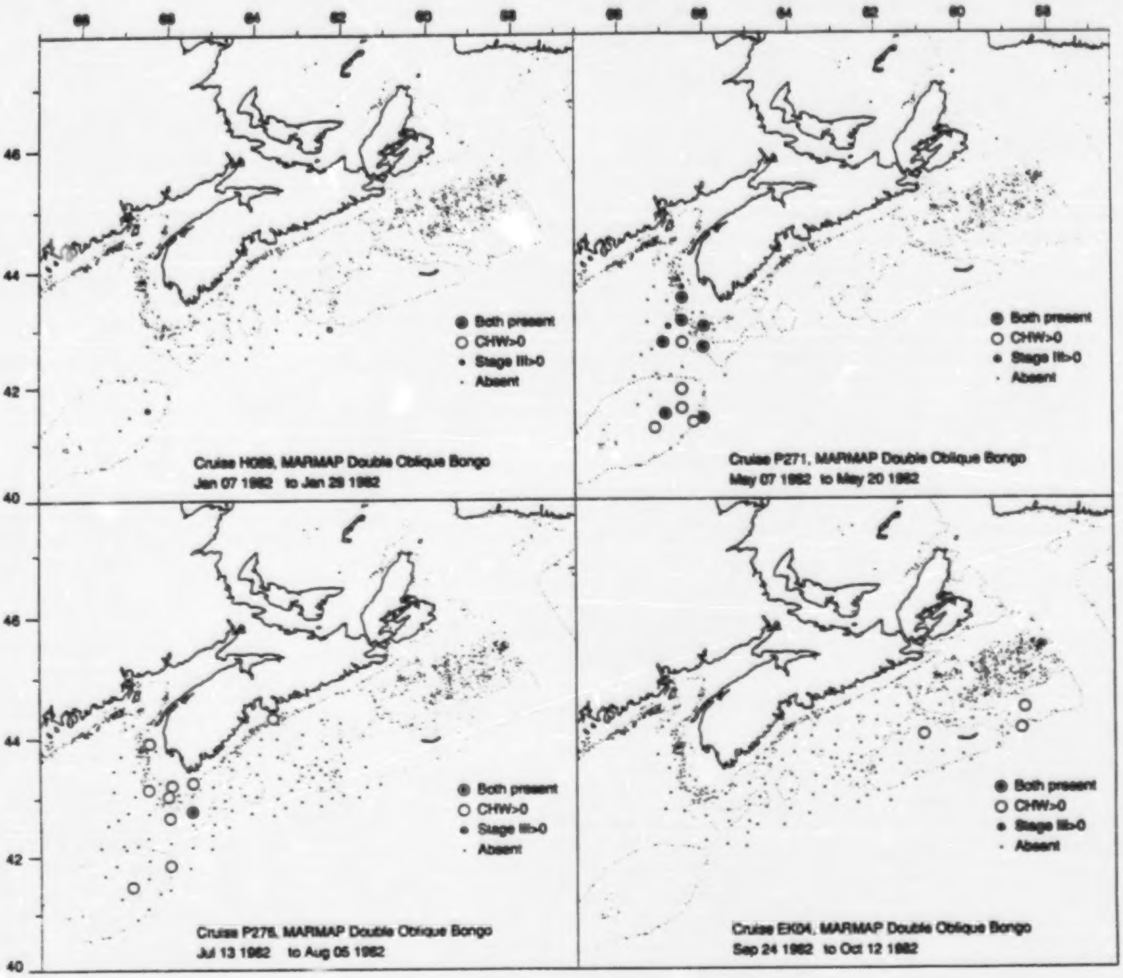

68
66
64
62
60
58
46
44
42
40
● Both present
○ CHW>0
• Stage III>0
· Absent
Cruise H069, MARMAP Double Oblique Bongo
Jan 07 1982 to Jan 28 1982
Cruise P271, MARMAP Double Oblique Bongo
May 07 1982 to May 20 1982
Cruise P276, MARMAP Double Oblique Bongo
Jul 13 1982 to Aug 05 1982
Cruise EK04, MARMAP Double Oblique Bongo
Sep 24 1982 to Oct 12 1982

Fig. 8.4.3. (continued).

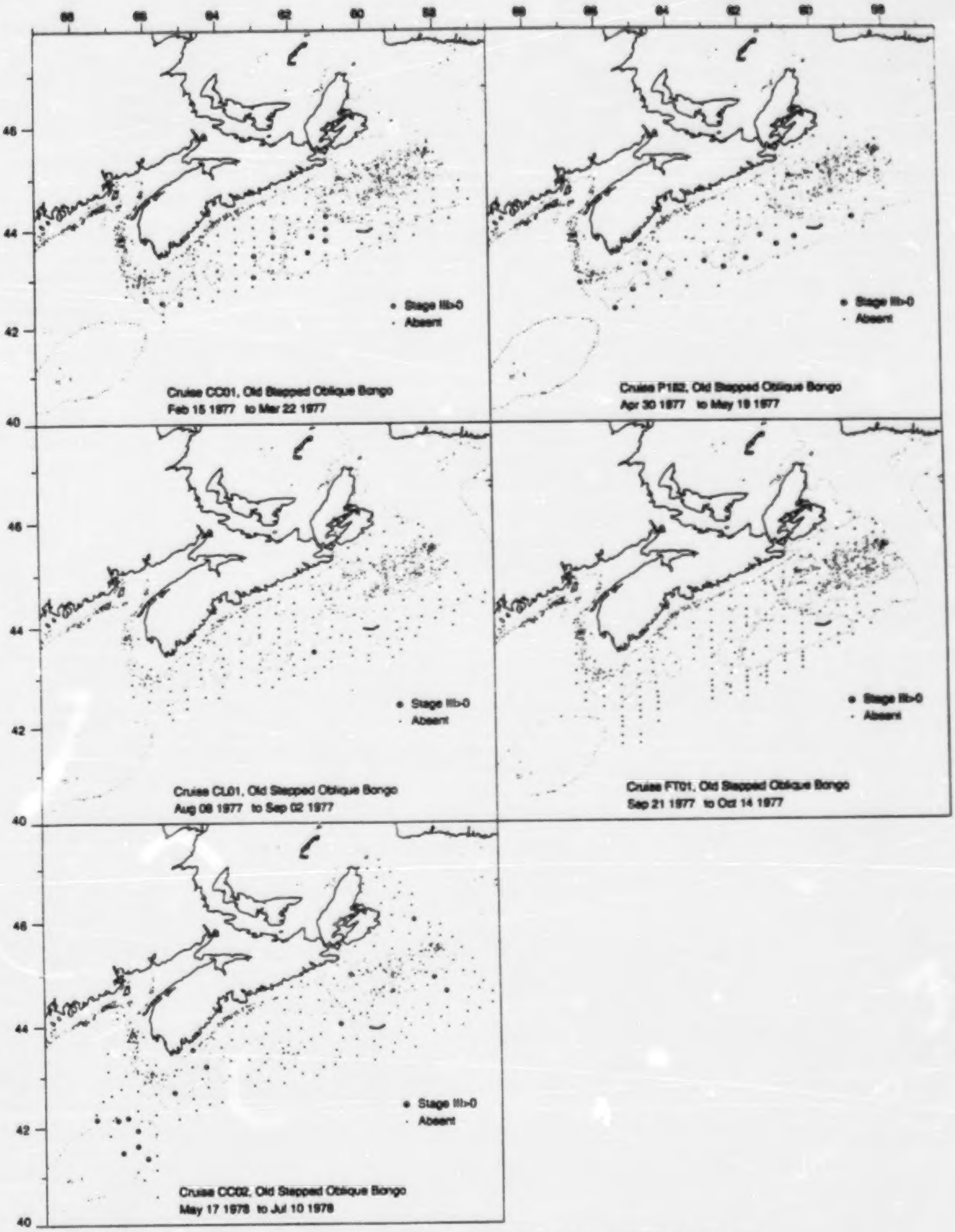

68
66
64
62
60
58
46
44
42
40
● Stage III>0
· Absent
Cruise CC01, Old Stepped Oblique Bongo
Feb 15 1977 to Mar 22 1977
Cruise P182, Old Stepped Oblique Bongo
Apr 30 1977 to May 19 1977
Cruise CL01, Old Stepped Oblique Bongo
Aug 08 1977 to Sep 02 1977
Cruise FT01, Old Stepped Oblique Bongo
Sep 21 1977 to Oct 14 1977
Cruise CC02, Old Stepped Oblique Bongo
May 17 1978 to Jul 10 1978

Fig. 8.4.4. Scotian Shelf Ichthyoplankton Program Cruises: Stage III haddock eggs.

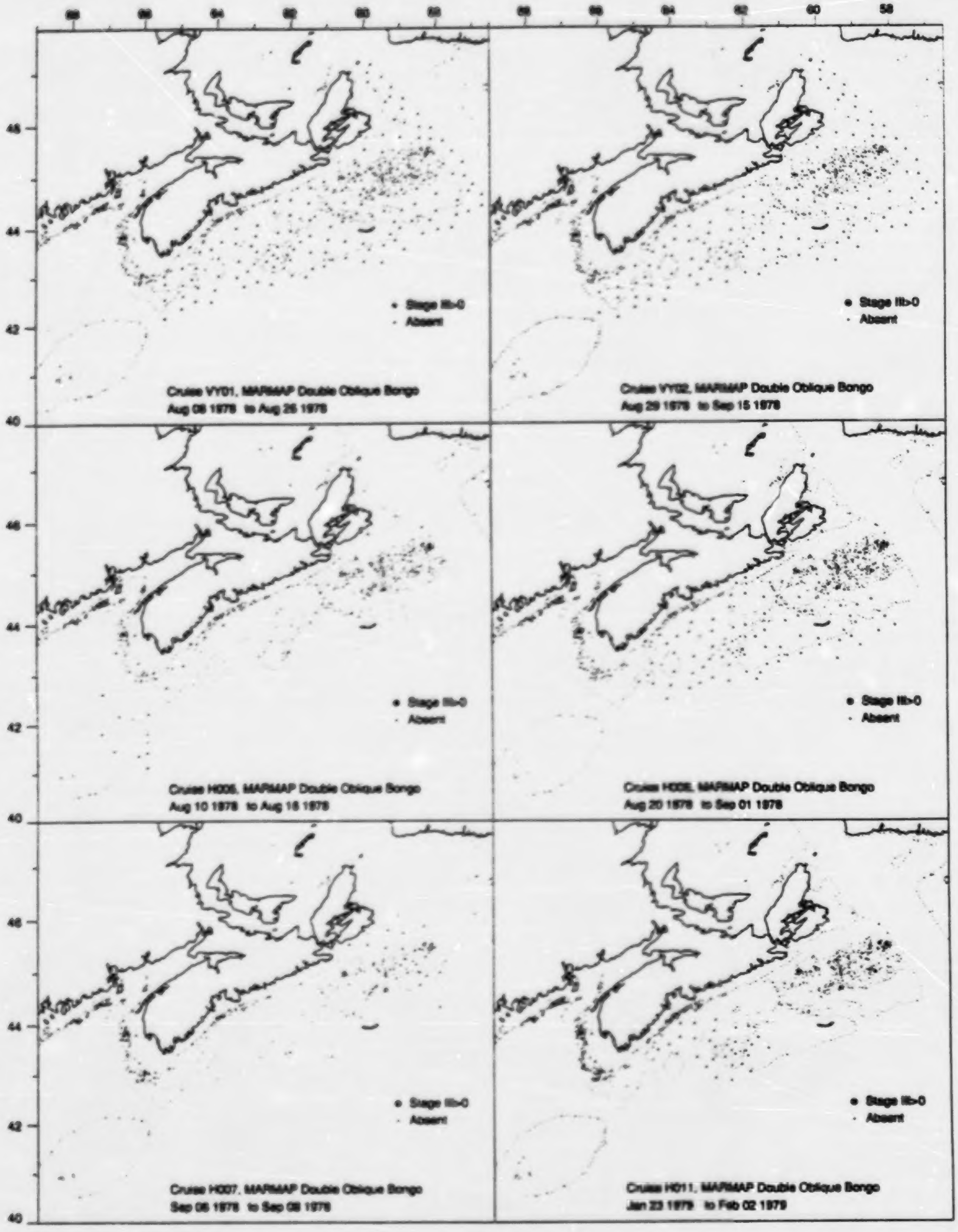
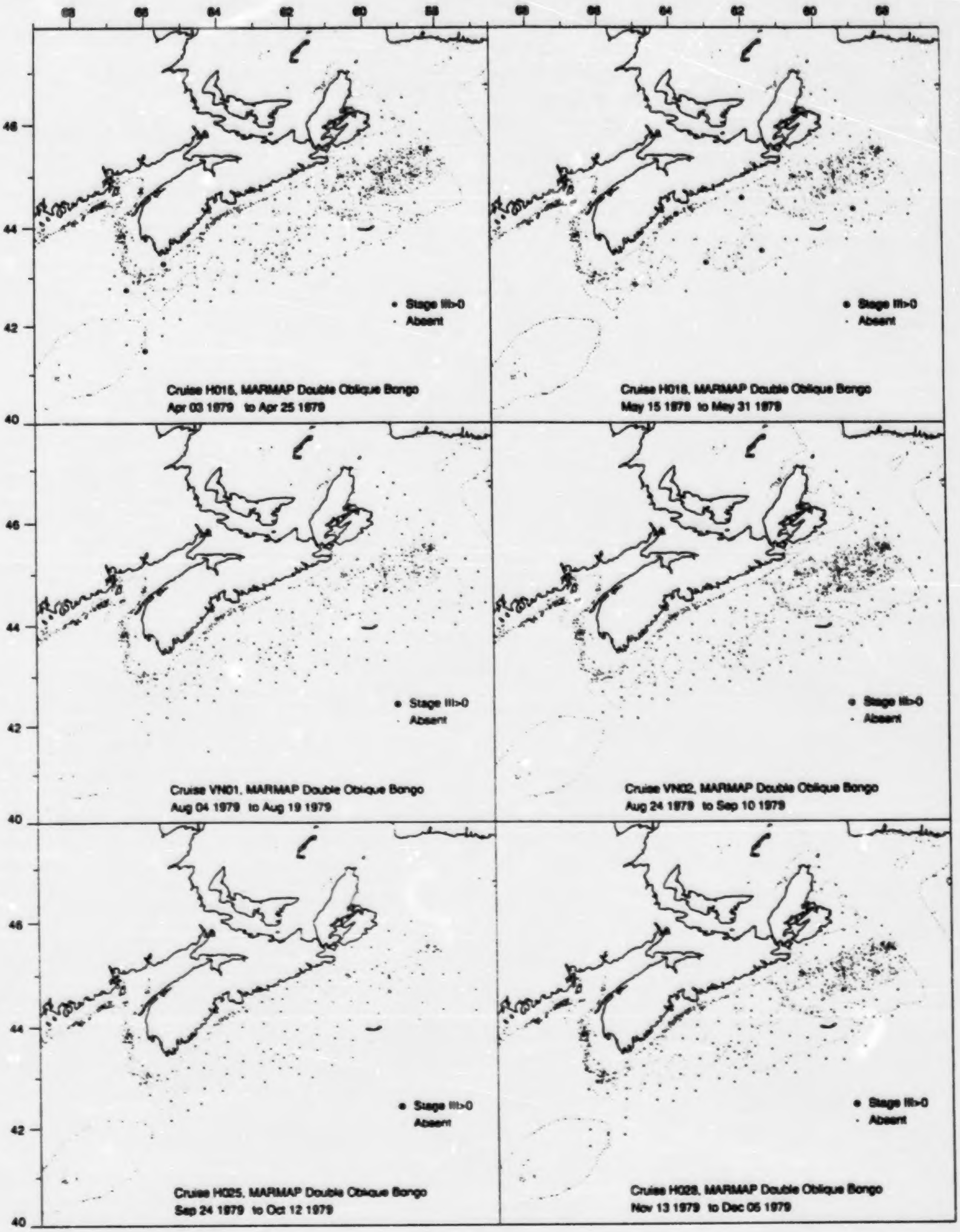

68
66
64
62
60
58
46
44
42
40
Stage III>0
Absent
Cruise VY01, MARMAP Double Oblique Bongo
Aug 08 1978 to Aug 26 1978
Cruise VY02, MARMAP Double Oblique Bongo
Aug 29 1978 to Sep 15 1978
Cruise H005, MARMAP Double Oblique Bongo
Aug 10 1978 to Aug 16 1978
Cruise H006, MARMAP Double Oblique Bongo
Aug 20 1978 to Sep 01 1978
Cruise H007, MARMAP Double Oblique Bongo
Sep 06 1978 to Sep 08 1978
Cruise H011, MARMAP Double Oblique Bongo
Jan 23 1979 to Feb 02 1979

Fig. 8.4.4. (continued).



Cruise H015, MARMAP Double Oblique Bongo
Apr 03 1979 to Apr 25 1979

Cruise H018, MARMAP Double Oblique Bongo
May 15 1979 to May 31 1979

Cruise VN01, MARMAP Double Oblique Bongo
Aug 04 1979 to Aug 19 1979

Cruise VN02, MARMAP Double Oblique Bongo
Aug 24 1979 to Sep 10 1979

Cruise H025, MARMAP Double Oblique Bongo
Sep 24 1979 to Oct 12 1979

Cruise H028, MARMAP Double Oblique Bongo
Nov 13 1979 to Dec 05 1979

Fig. 8.4.4. (continued).

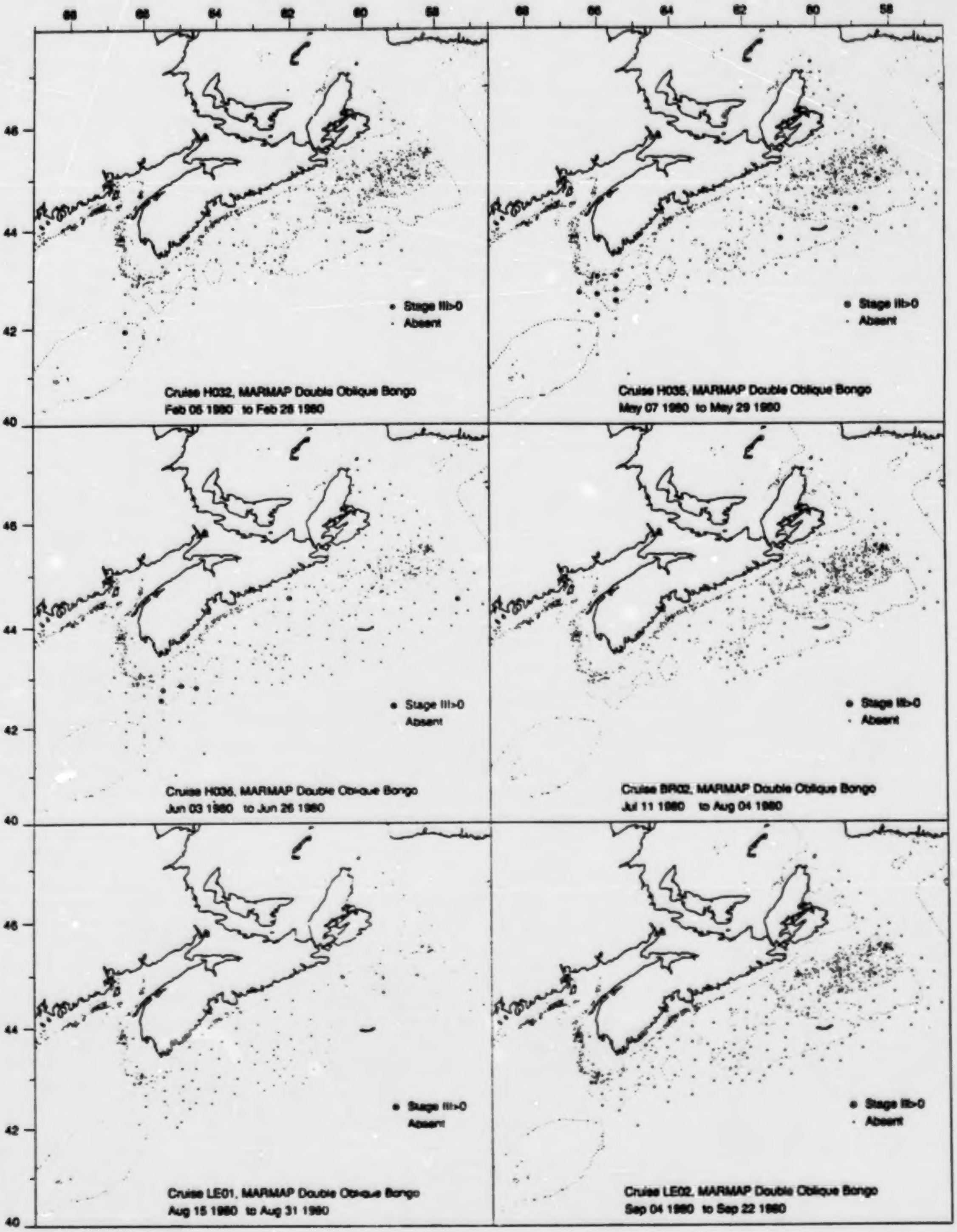

68
66
64
62
60
58
46
44
42
40
Stage III>0
Absent
Cruise H032, MARMAP Double Oblique Bongo
Feb 05 1980 to Feb 28 1980
Cruise H035, MARMAP Double Oblique Bongo
May 07 1980 to May 29 1980
Cruise H036, MARMAP Double Oblique Bongo
Jun 03 1980 to Jun 26 1980
Cruise BR02, MARMAP Double Oblique Bongo
Jul 11 1980 to Aug 04 1980
Cruise LE01, MARMAP Double Oblique Bongo
Aug 15 1980 to Aug 31 1980
Cruise LE02, MARMAP Double Oblique Bongo
Sep 04 1980 to Sep 22 1980

Fig. 8.4.4. (continued).

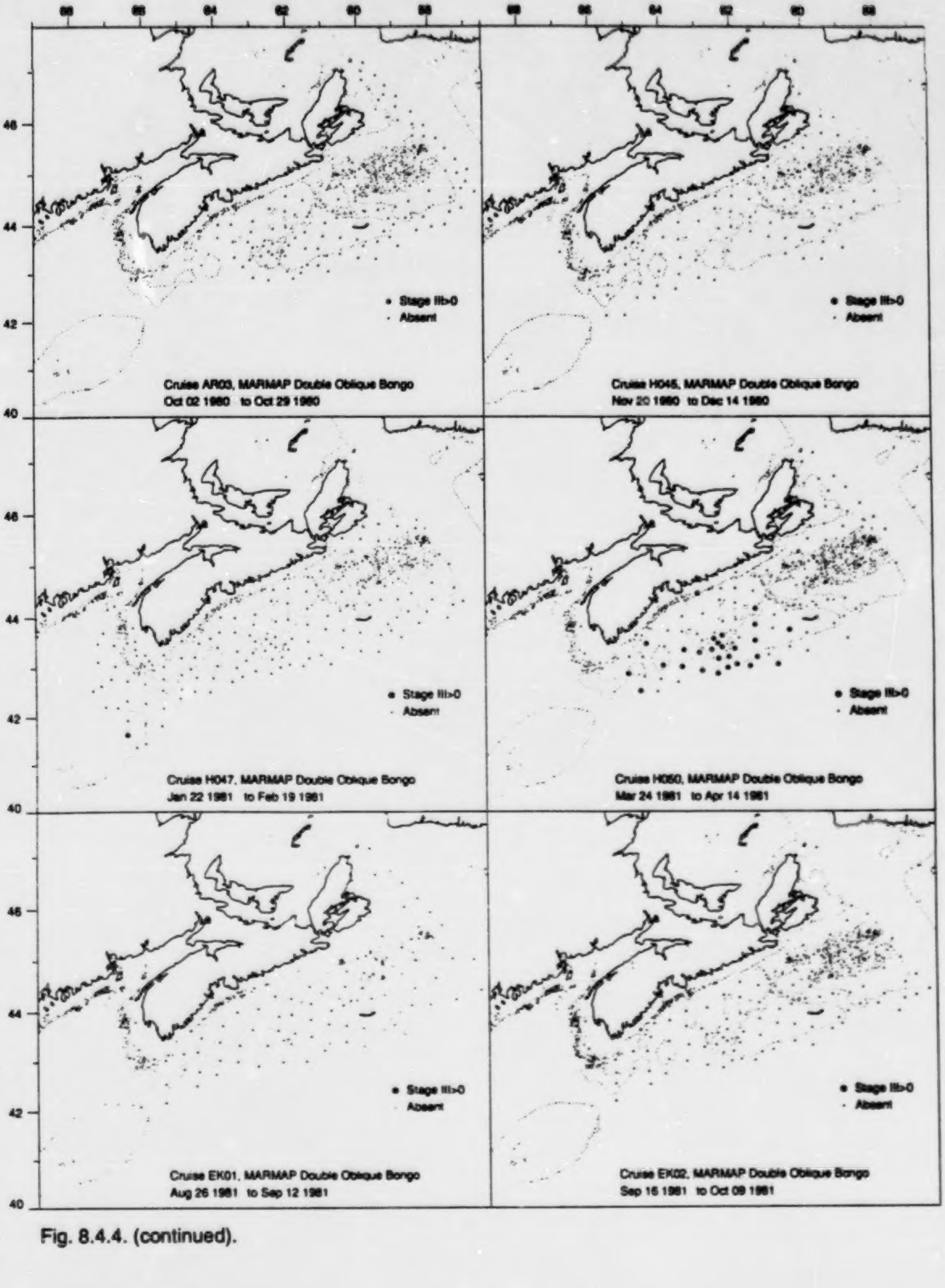
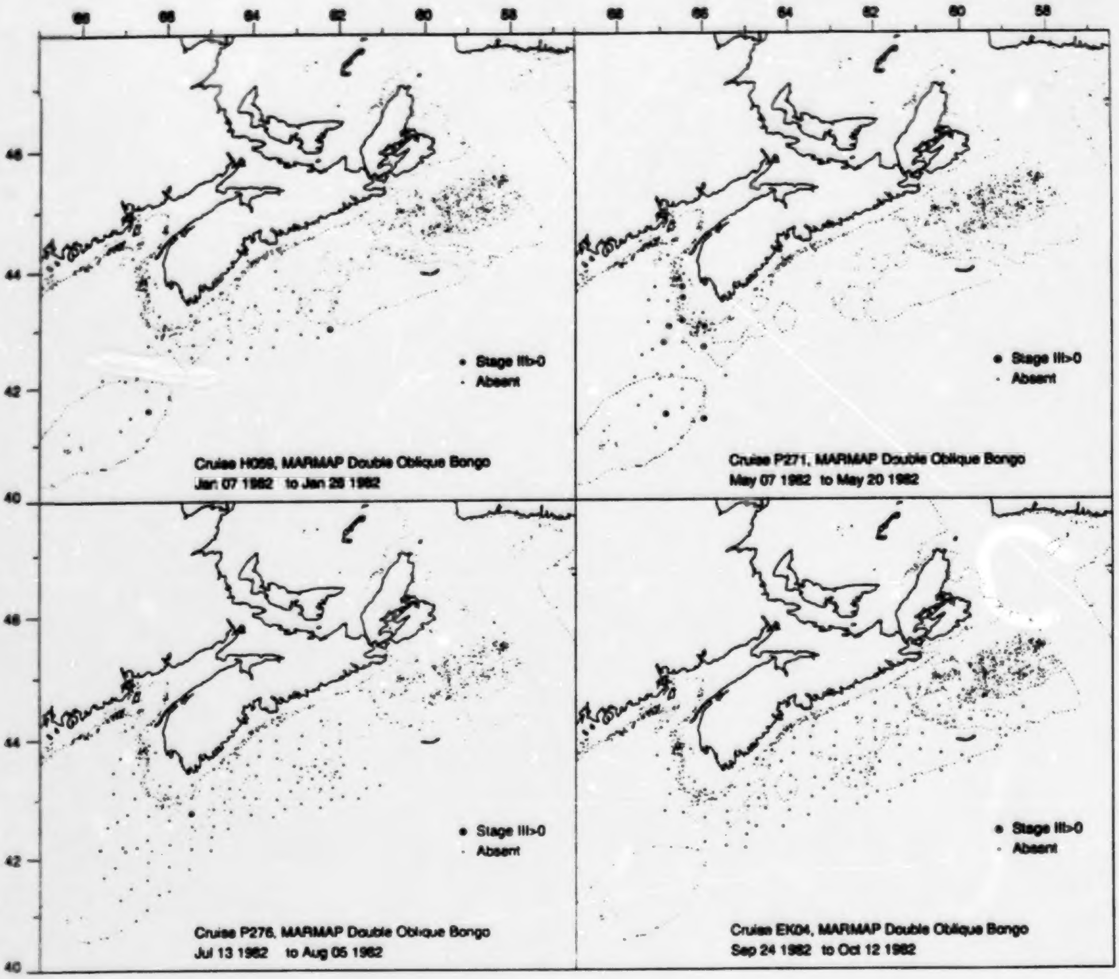

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
● Stage III>0
· Absent
Cruise AR03, MARMAP Double Oblique Bongo
Oct 02 1980 to Oct 29 1980
● Stage III>0
· Absent
Cruise H045, MARMAP Double Oblique Bongo
Nov 20 1980 to Dec 14 1980
● Stage III>0
· Absent
Cruise H047, MARMAP Double Oblique Bongo
Jan 22 1981 to Feb 19 1981
● Stage III>0
· Absent
Cruise H050, MARMAP Double Oblique Bongo
Mar 24 1981 to Apr 14 1981
● Stage III>0
· Absent
Cruise EK01, MARMAP Double Oblique Bongo
Aug 26 1981 to Sep 12 1981
● Stage III>0
· Absent
Cruise EK02, MARMAP Double Oblique Bongo
Sep 16 1981 to Oct 09 1981

Fig. 8.4.4. (continued).


68
66
64
62
60
58
46
44
42
40
Stage III>0
Absent

Cruise H059, MARMAP Double Oblique Bongo
Jan 07 1982 to Jan 28 1982

Cruise P271, MARMAP Double Oblique Bongo
May 07 1982 to May 20 1982

Cruise P276, MARMAP Double Oblique Bongo
Jul 13 1982 to Aug 05 1982

Cruise EK04, MARMAP Double Oblique Bongo
Sep 24 1982 to Oct 12 1982

Fig. 8.4.4. (continued).

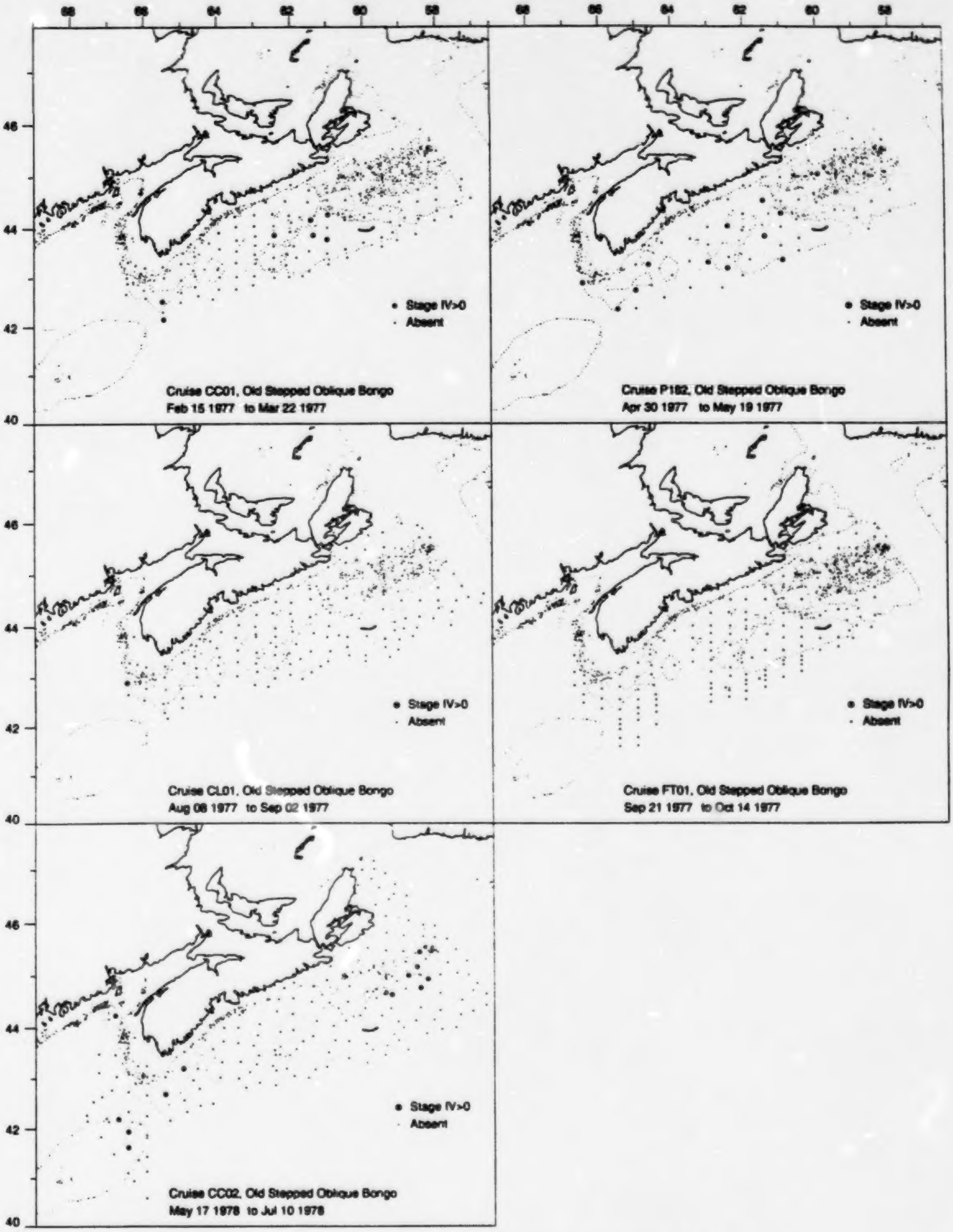

68
66
64
62
60
58
46
44
42
40
Stage IV>0
Absent
Cruise CC01, Old Stepped Oblique Bongo
Feb 15 1977 to Mar 22 1977
Cruise P182, Old Stepped Oblique Bongo
Apr 30 1977 to May 19 1977
Cruise CL01, Old Stepped Oblique Bongo
Aug 08 1977 to Sep 02 1977
Cruise FT01, Old Stepped Oblique Bongo
Sep 21 1977 to Oct 14 1977
Cruise CC02, Old Stepped Oblique Bongo
May 17 1978 to Jul 10 1978

Fig. 8.4.5. Scotian Shelf Ichthyoplankton Program Cruises: Stage IV haddock eggs.

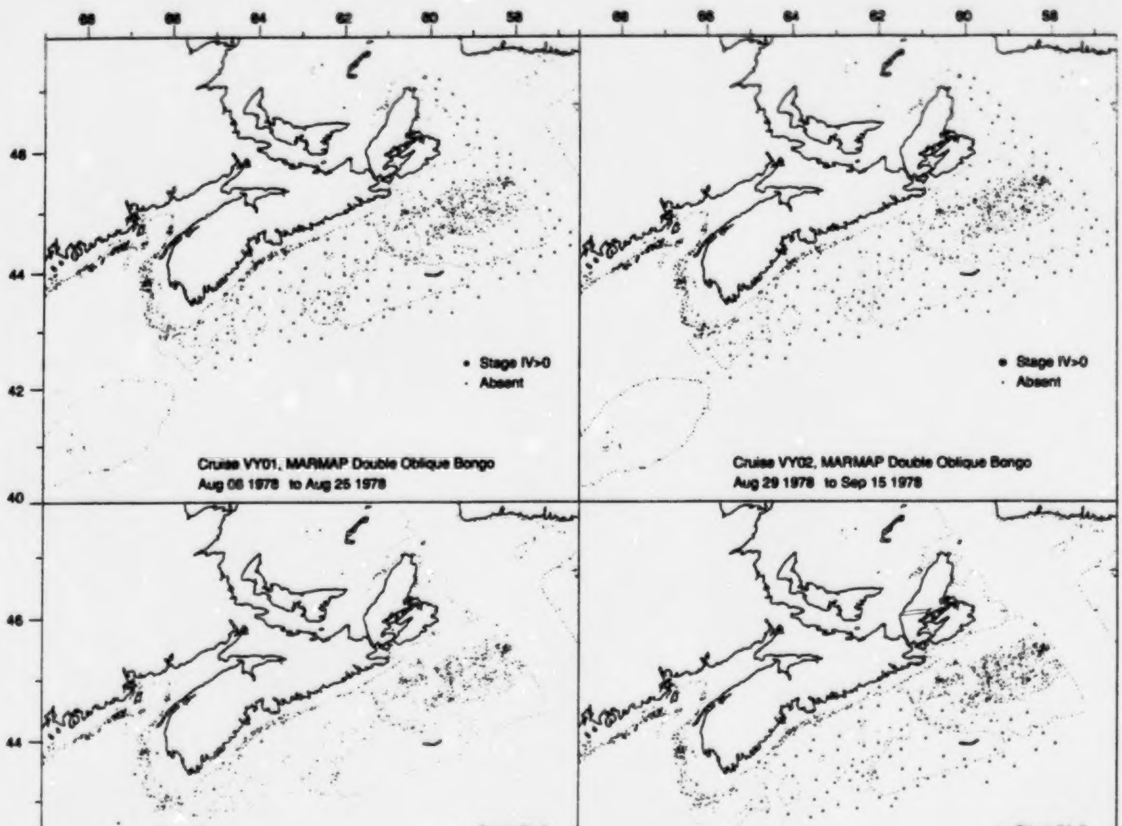
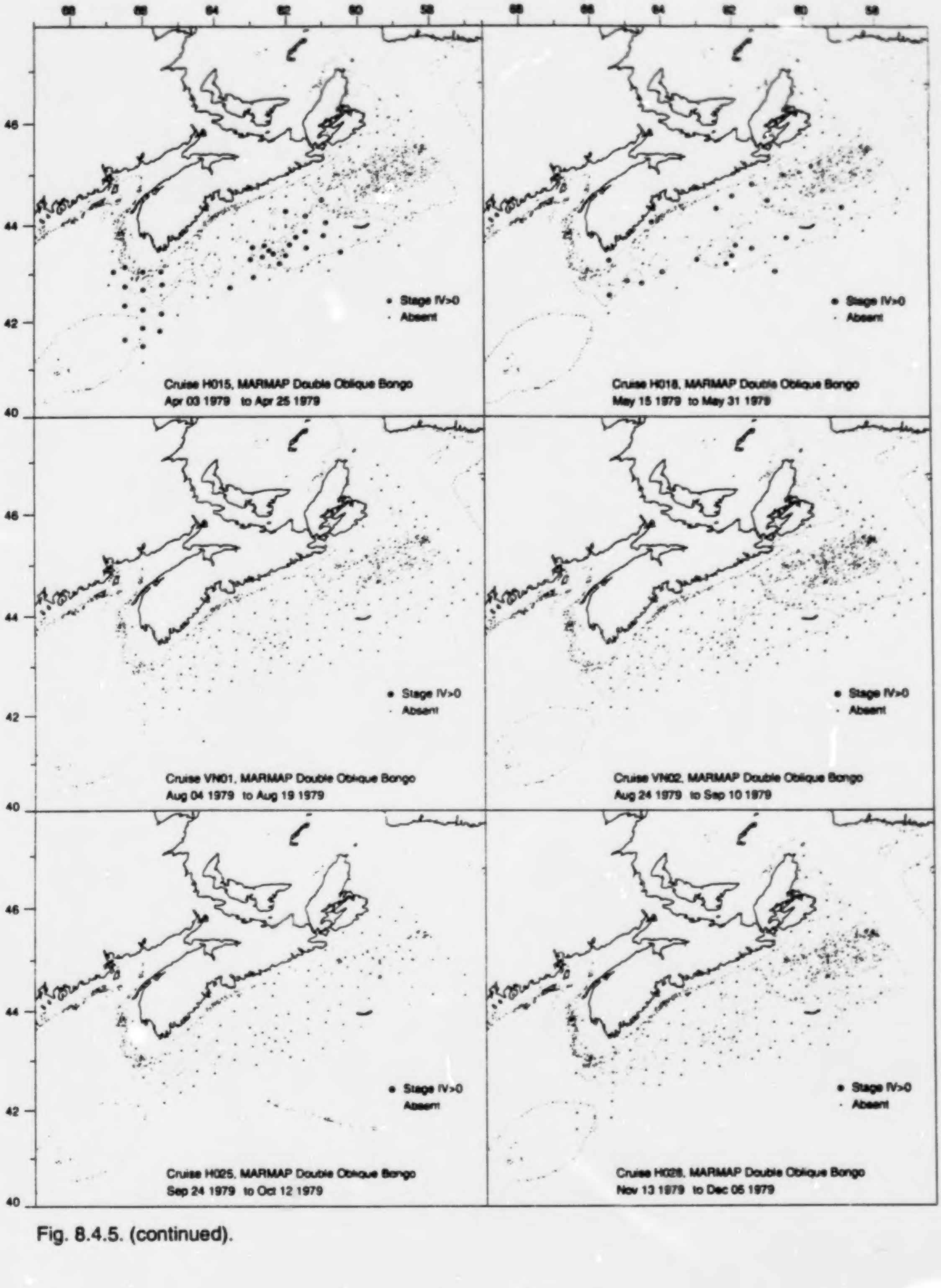

68
66
64
62
60
58
46
44
42
40
Stage IV>0
Absent
Cruise VY01, MARMAP Double Oblique Bongo
Aug 08 1978 to Aug 25 1978
Cruise VY02, MARMAP Double Oblique Bongo
Aug 29 1978 to Sep 15 1978
Cruise H006, MARMAP Double Oblique Bongo
Aug 10 1978 to Aug 16 1978
Cruise H005, MARMAP Double Oblique Bongo
Aug 20 1978 to Sep 01 1978
Cruise H007, MARMAP Double Oblique Bongo
Sep 06 1978 to Sep 08 1978
Cruise H011, MARMAP Double Oblique Bongo
Jan 23 1979 to Feb 02 1979

Fig. 8.4.5. (continued).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66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
● Stage IV>0
· Absent
Cruise H015, MARMAP Double Oblique Bongo
Apr 03 1979 to Apr 25 1979
● Stage IV>0
· Absent
Cruise H018, MARMAP Double Oblique Bongo
May 15 1979 to May 31 1979
● Stage IV>0
· Absent
Cruise VN01, MARMAP Double Oblique Bongo
Aug 04 1979 to Aug 19 1979
● Stage IV>0
· Absent
Cruise VN02, MARMAP Double Oblique Bongo
Aug 24 1979 to Sep 10 1979
● Stage IV>0
· Absent
Cruise H025, MARMAP Double Oblique Bongo
Sep 24 1979 to Oct 12 1979
● Stage IV>0
· Absent
Cruise H028, MARMAP Double Oblique Bongo
Nov 13 1979 to Dec 05 1979

Fig. 8.4.5. (continued).

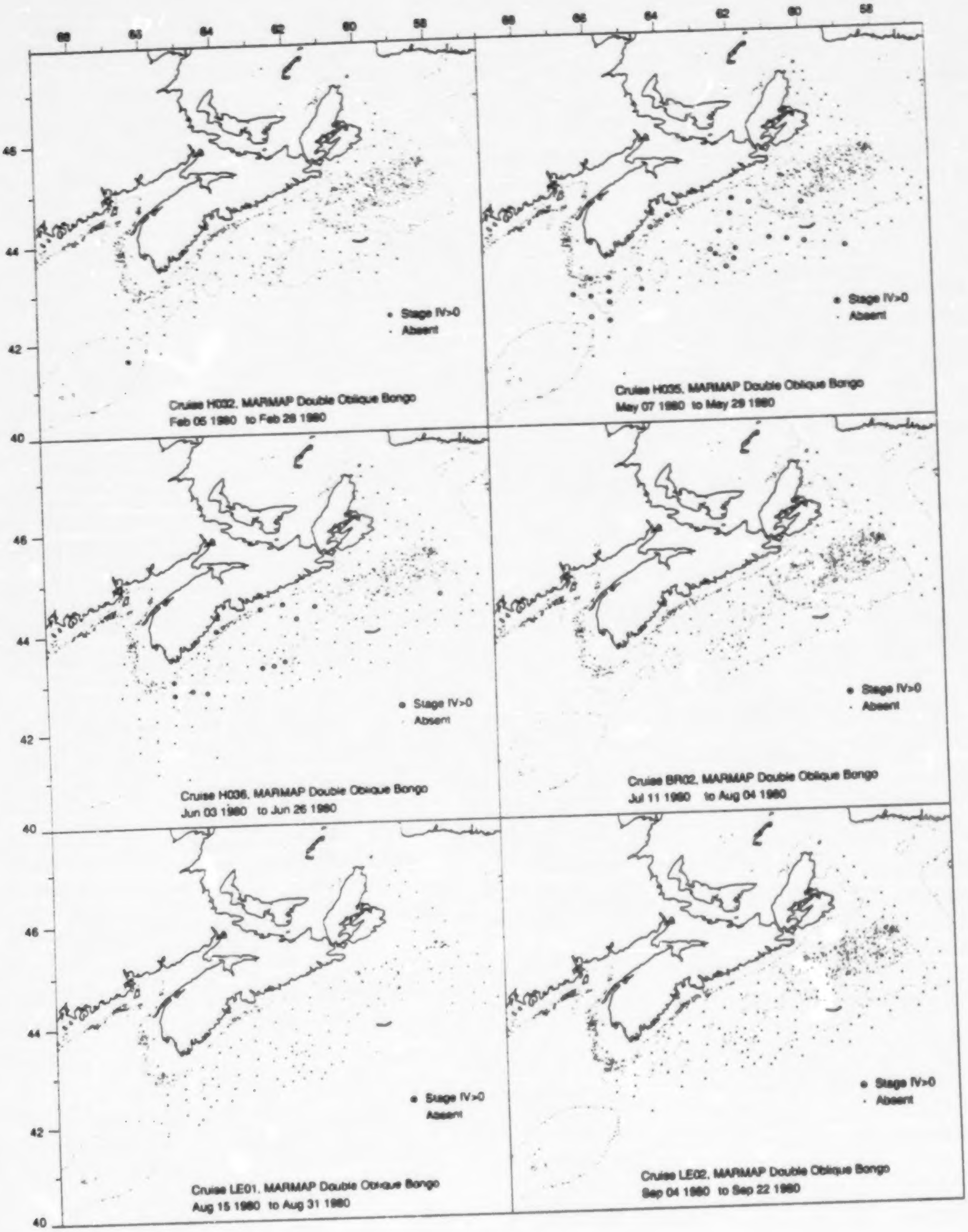

68
66
64
62
60
58
46
44
42
40
Stage IV>0
Absent
Cruise H032, MARMAP Double Oblique Bongo
Feb 05 1980 to Feb 28 1980
Cruise H035, MARMAP Double Oblique Bongo
May 07 1980 to May 29 1980
Cruise H036, MARMAP Double Oblique Bongo
Jun 03 1980 to Jun 26 1980
Cruise BR02, MARMAP Double Oblique Bongo
Jul 11 1980 to Aug 04 1980
Cruise LE01, MARMAP Double Oblique Bongo
Aug 15 1980 to Aug 31 1980
Cruise LE02, MARMAP Double Oblique Bongo
Sep 04 1980 to Sep 22 1980

Fig. 8.4.5. (continued).

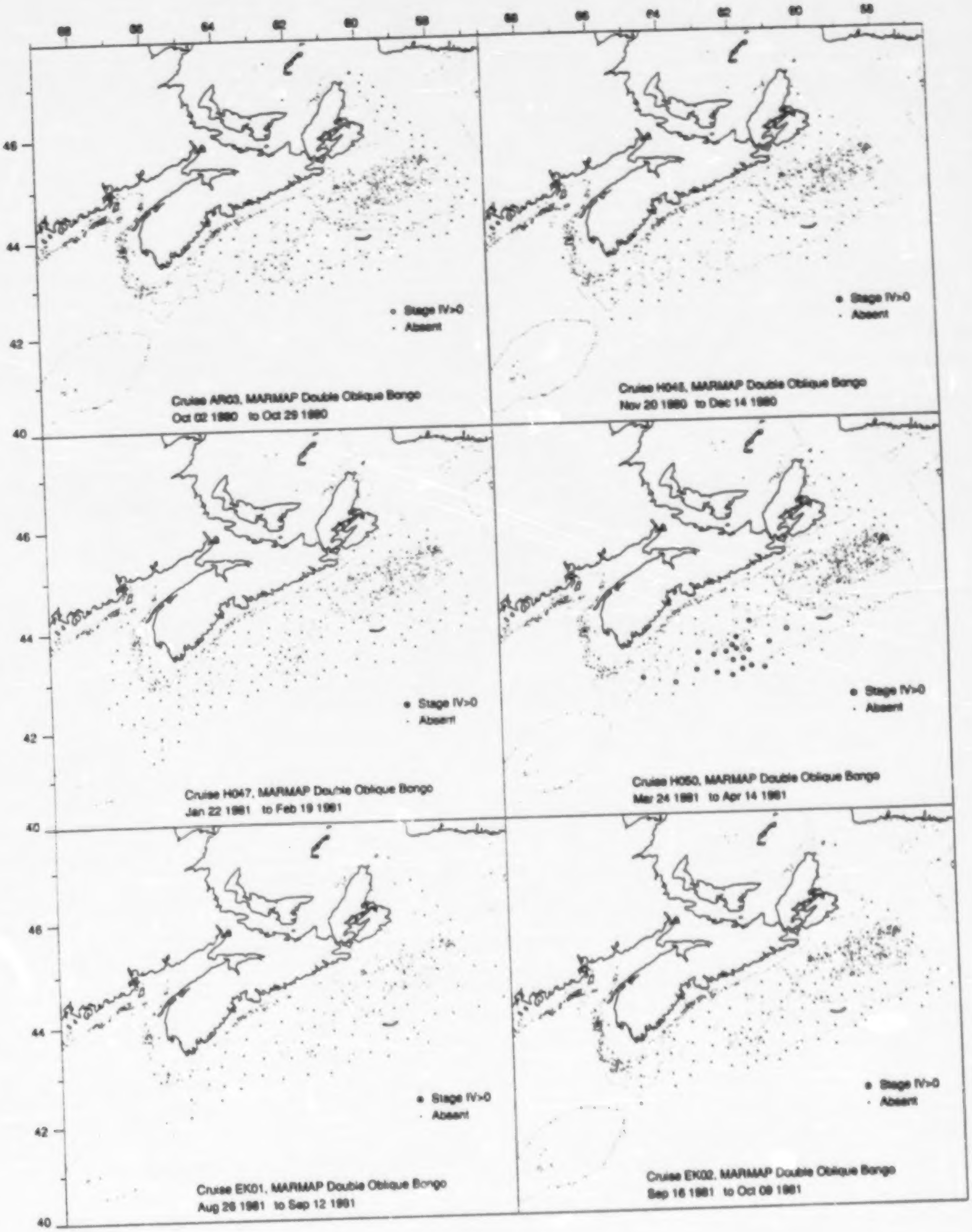

68
66
64
62
60
58
46
44
42
40
Stage IV>0
Absent
Cruise AR03, MARMAP Double Oblique Bongo
Oct 02 1980 to Oct 29 1980
Cruise H046, MARMAP Double Oblique Bongo
Nov 20 1980 to Dec 14 1980
Cruise H047, MARMAP Double Oblique Bongo
Jan 22 1981 to Feb 19 1981
Cruise H050, MARMAP Double Oblique Bongo
Mar 24 1981 to Apr 14 1981
Cruise EK01, MARMAP Double Oblique Bongo
Aug 26 1981 to Sep 12 1981
Cruise EK02, MARMAP Double Oblique Bongo
Sep 16 1981 to Oct 09 1981

Fig. 8.4.5. (continued).

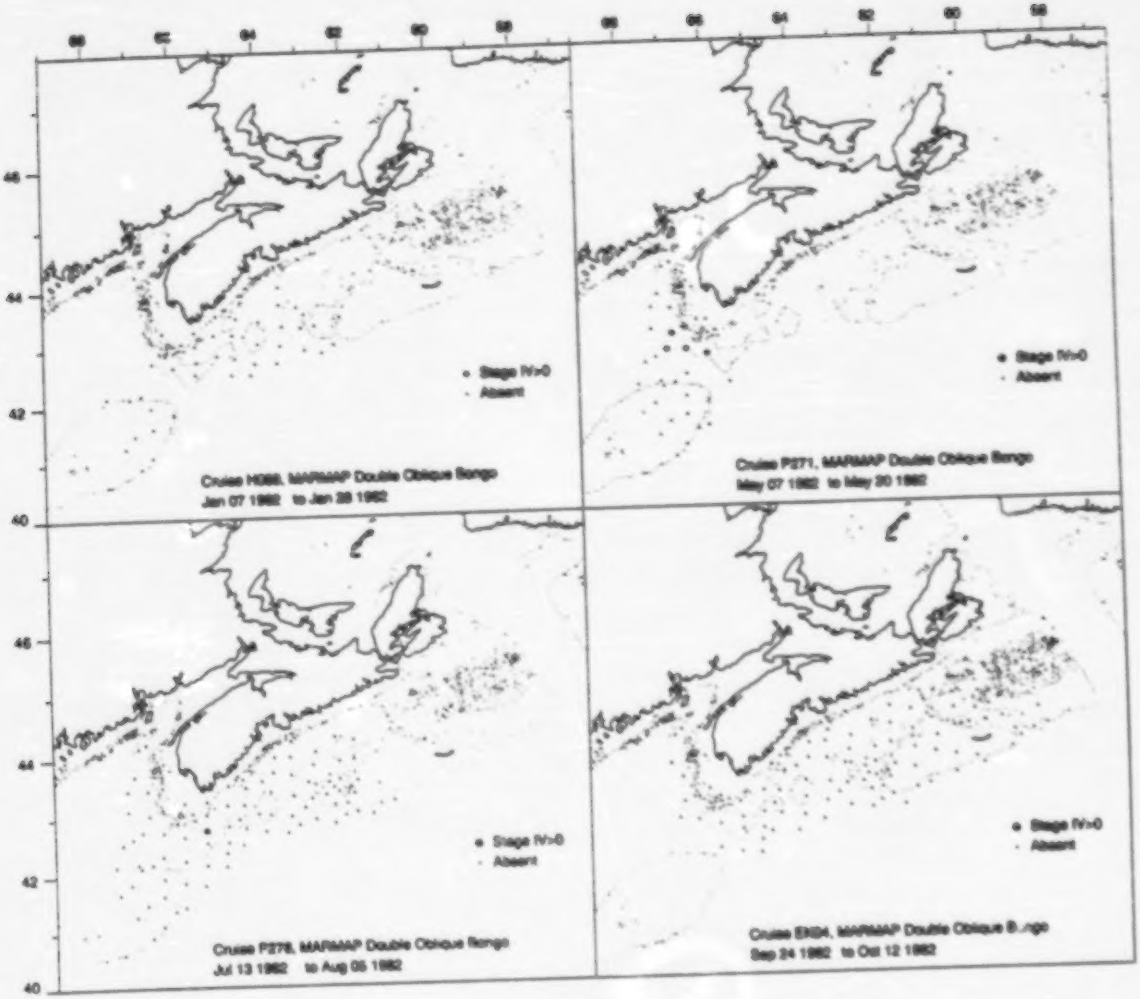
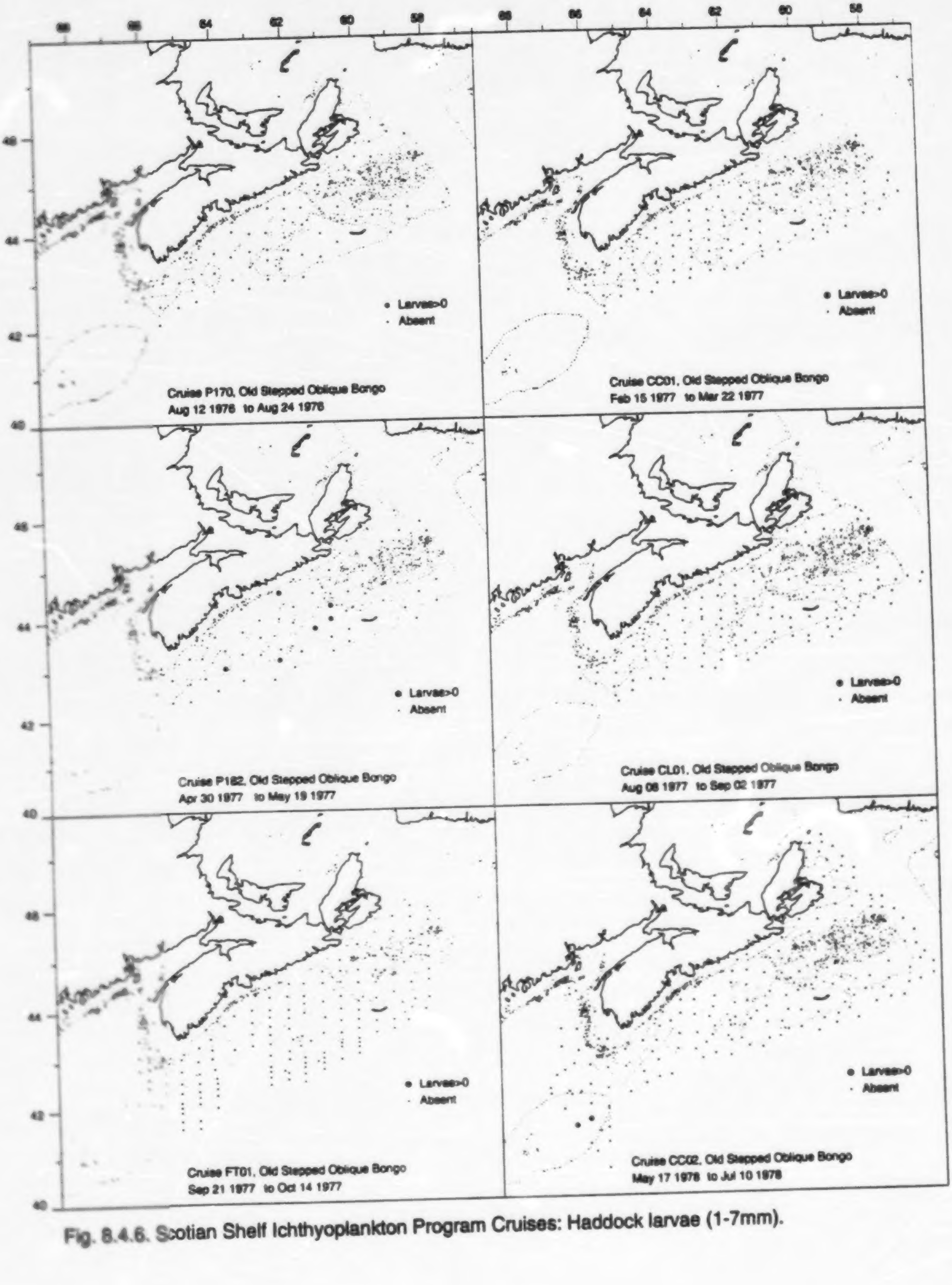

68
66
64
62
60
58
46
44
42
40
Stage IV>0
Absent
Cruise H088, MARMAP Double Oblique Bongo
Jan 07 1982 to Jan 28 1982
Cruise P271, MARMAP Double Oblique Bongo
May 07 1982 to May 20 1982
Cruise P278, MARMAP Double Oblique Bongo
Jul 13 1982 to Aug 05 1982
Cruise EK84, MARMAP Double Oblique B.ngo
Sep 24 1982 to Oct 12 1982

Fig. 8.4.5. (continued).



Cruise P170, Old Stepped Oblique Bongo
Aug 12 1976 to Aug 24 1976

Cruise CC01, Old Stepped Oblique Bongo
Feb 15 1977 to Mar 22 1977

Cruise P182, Old Stepped Oblique Bongo
Apr 30 1977 to May 19 1977

Cruise CL01, Old Stepped Oblique Bongo
Aug 08 1977 to Sep 02 1977

Cruise FT01, Old Stepped Oblique Bongo
Sep 21 1977 to Oct 14 1977

Cruise CC02, Old Stepped Oblique Bongo
May 17 1978 to Jul 10 1978

Fig. 8.4.6. Scotian Shelf Ichthyoplankton Program Cruises: Haddock larvae (1-7mm).

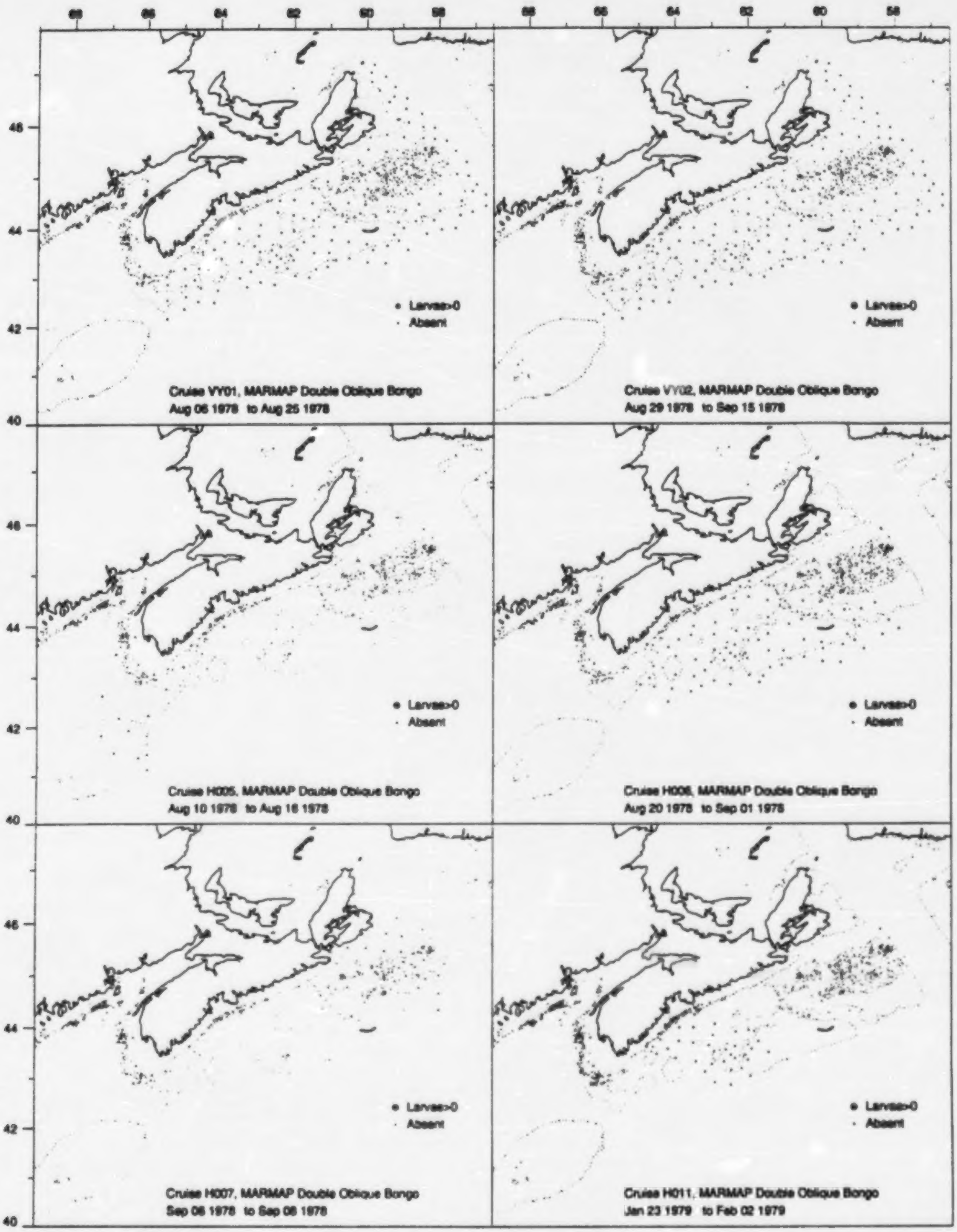
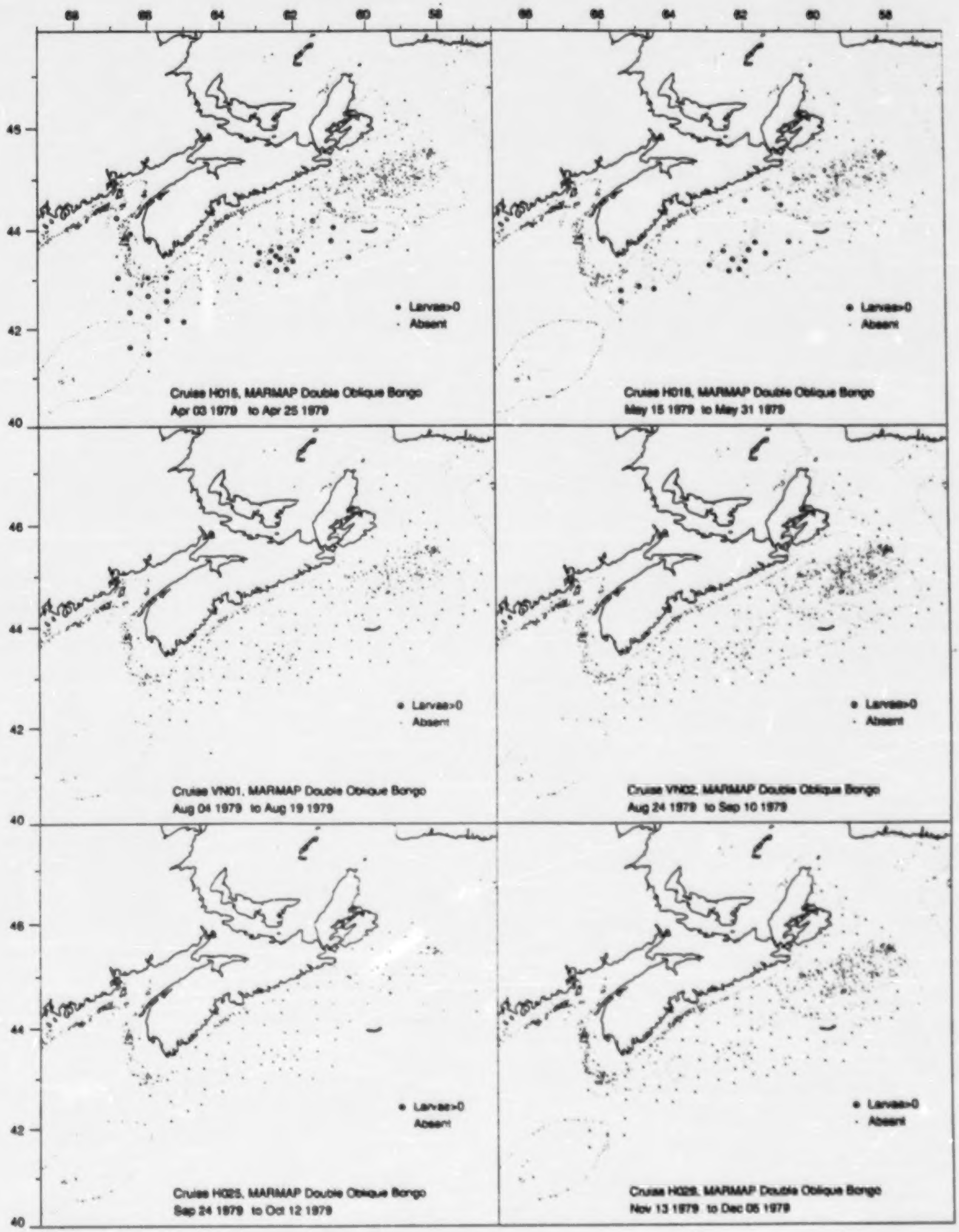

68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
● Larvae>0
· Absent
Cruise VY01, MARMAP Double Oblique Bongo
Aug 06 1978 to Aug 25 1978
● Larvae>0
· Absent
Cruise VY02, MARMAP Double Oblique Bongo
Aug 29 1978 to Sep 15 1978
● Larvae>0
· Absent
Cruise H005, MARMAP Double Oblique Bongo
Aug 10 1978 to Aug 16 1978
● Larvae>0
· Absent
Cruise H006, MARMAP Double Oblique Bongo
Aug 20 1978 to Sep 01 1978
● Larvae>0
· Absent
Cruise H007, MARMAP Double Oblique Bongo
Sep 06 1978 to Sep 08 1978
● Larvae>0
· Absent
Cruise H011, MARMAP Double Oblique Bongo
Jan 23 1979 to Feb 02 1979

Fig. 8.4.6. (continued).


68
66
64
62
60
58
68
66
64
62
60
58
46
44
42
40
46
44
42
40
46
44
42
40
● Larvae>0
· Absent

Cruise H015, MARMAP Double Oblique Bongo
Apr 03 1979 to Apr 25 1979

Cruise H018, MARMAP Double Oblique Bongo
May 15 1979 to May 31 1979

Cruise VN01, MARMAP Double Oblique Bongo
Aug 04 1979 to Aug 19 1979

Cruise VN02, MARMAP Double Oblique Bongo
Aug 24 1979 to Sep 10 1979

Cruise H025, MARMAP Double Oblique Bongo
Sep 24 1979 to Oct 12 1979

Cruise H028, MARMAP Double Oblique Bongo
Nov 13 1979 to Dec 05 1979

Fig. 8.4.6. (continued).

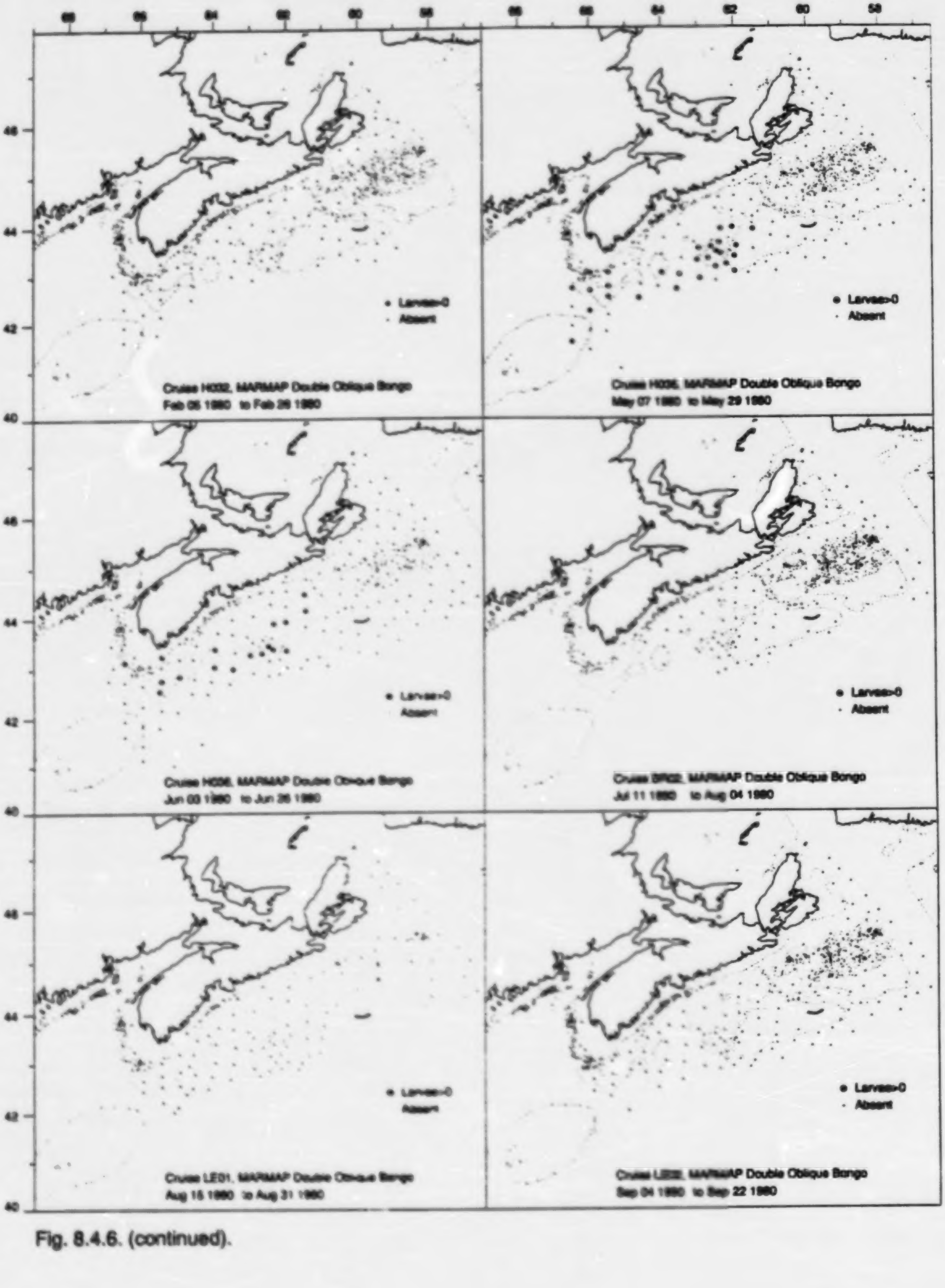
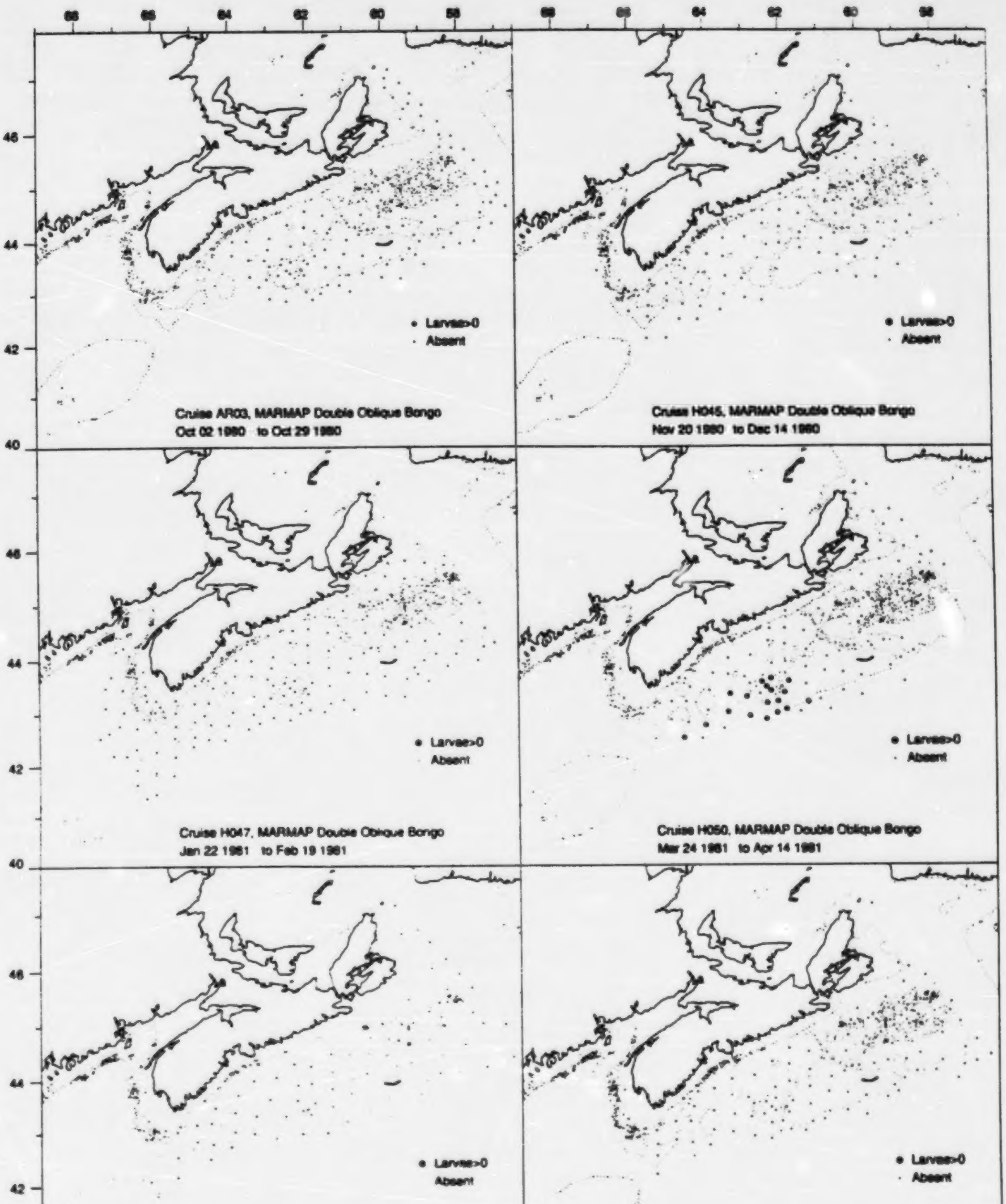

68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent
Cruise H032, MARMAP Double Oblique Bongo
Feb 05 1980 to Feb 29 1980
Cruise H036, MARMAP Double Oblique Bongo
May 07 1980 to May 29 1980
Cruise H038, MARMAP Double Oblique Bongo
Jun 03 1980 to Jun 26 1980
Cruise BR02, MARMAP Double Oblique Bongo
Jul 11 1980 to Aug 04 1980
Cruise LE01, MARMAP Double Oblique Bongo
Aug 15 1980 to Aug 31 1980
Cruise LE02, MARMAP Double Oblique Bongo
Sep 04 1980 to Sep 22 1980

Fig. 8.4.6. (continued).



Cruise AR03, MARMAP Double Oblique Bongo
Oct 02 1980 to Oct 29 1980

Cruise H045, MARMAP Double Oblique Bongo
Nov 20 1980 to Dec 14 1980

Cruise H047, MARMAP Double Oblique Bongo
Jan 22 1981 to Feb 19 1981

Cruise H050, MARMAP Double Oblique Bongo
Mar 24 1981 to Apr 14 1981

Cruise EK01, MARMAP Double Oblique Bongo
Aug 26 1981 to Sep 12 1981

Cruise EK02, MARMAP Double Oblique Bongo
Sep 16 1981 to Oct 09 1981

Fig. 8.4.6. (continued).

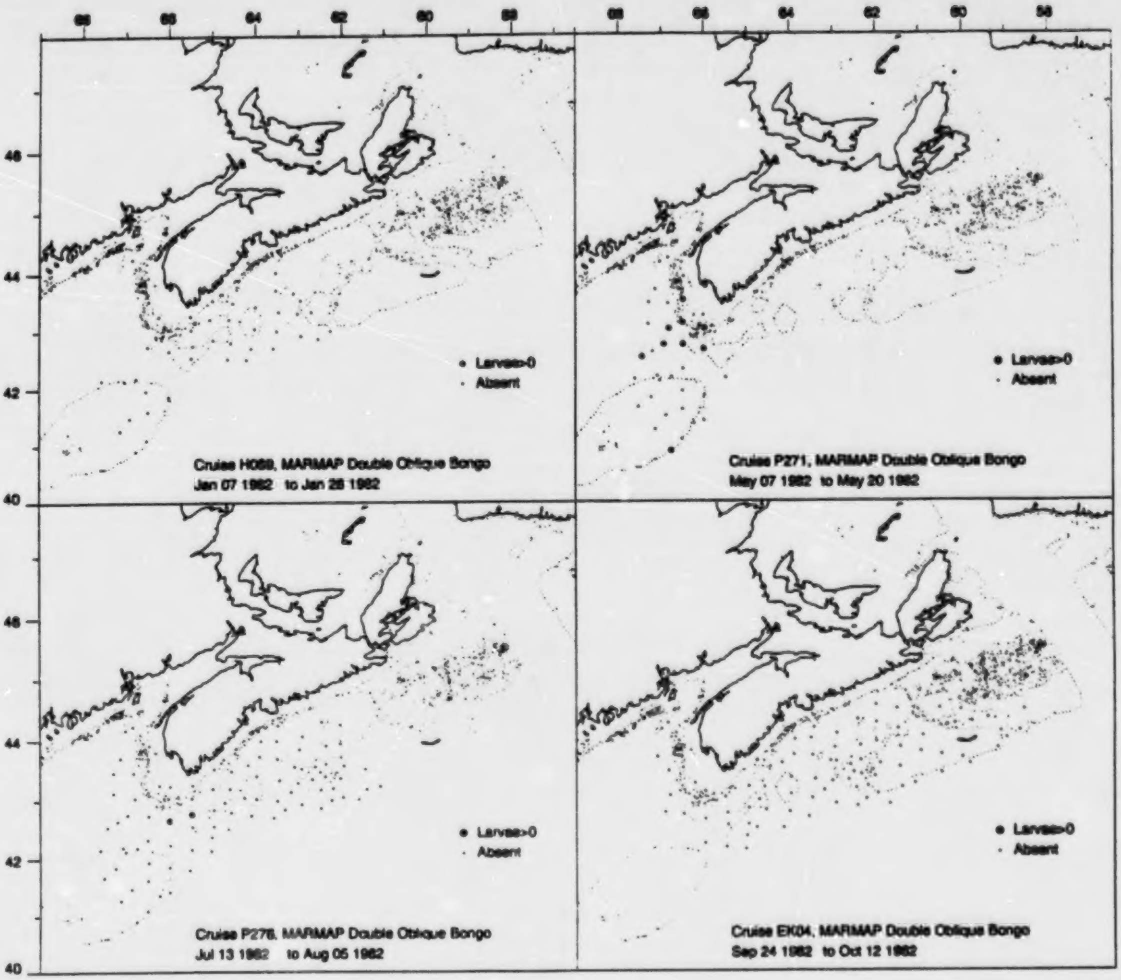

68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent
Cruise H069, MARMAP Double Oblique Bongo
Jan 07 1982 to Jan 26 1982
Cruise P271, MARMAP Double Oblique Bongo
May 07 1982 to May 20 1982
Cruise P276, MARMAP Double Oblique Bongo
Jul 13 1982 to Aug 05 1982
Cruise EK04, MARMAP Double Oblique Bongo
Sep 24 1982 to Oct 12 1982

Fig. 8.4.6. (continued).

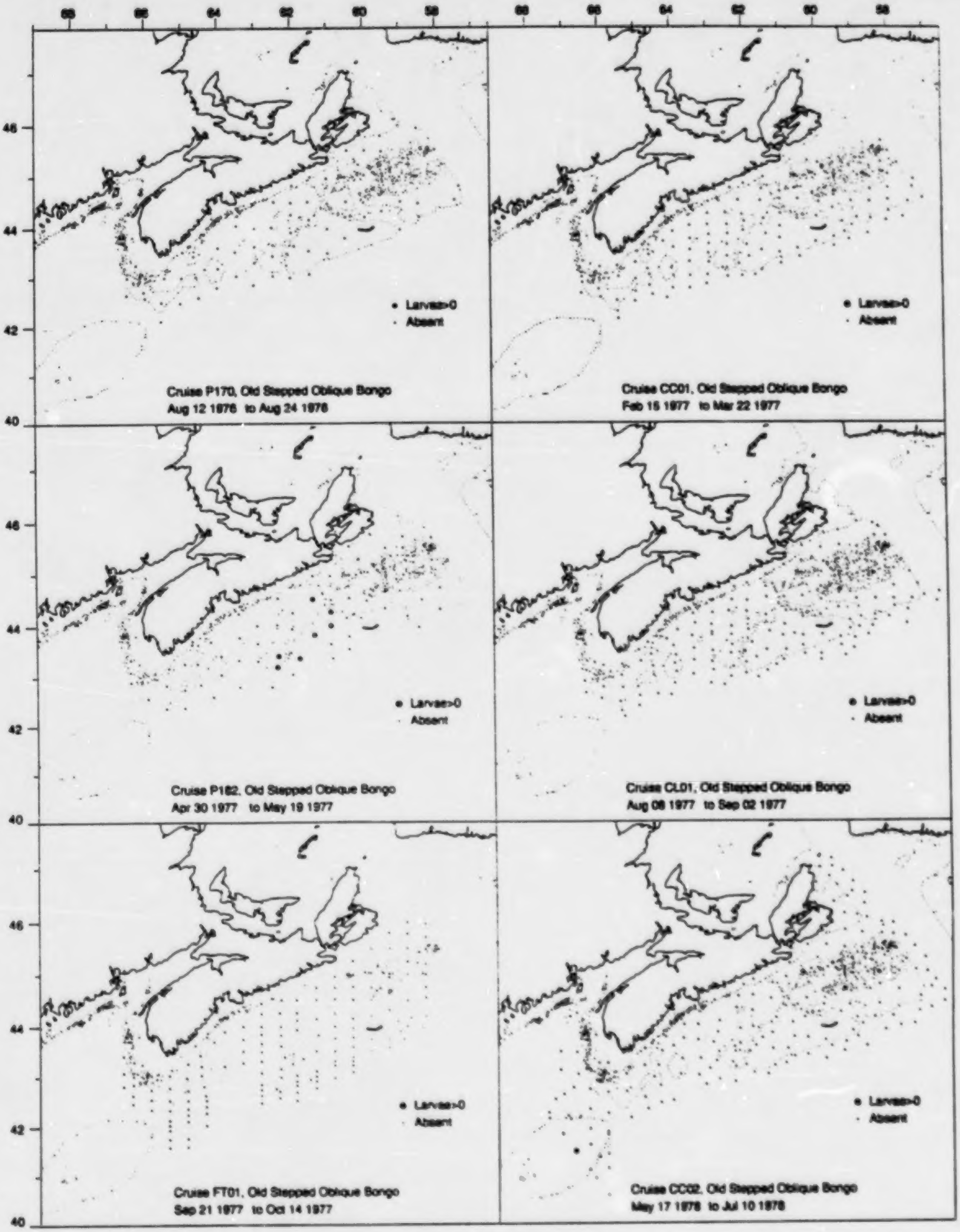

68
66
64
62
60
58
46
44
42
40
● Larvae>0
· Absent
Cruise P170, Old Stepped Oblique Bongo
Aug 12 1976 to Aug 24 1976
Cruise CC01, Old Stepped Oblique Bongo
Feb 15 1977 to Mar 22 1977
Cruise P182, Old Stepped Oblique Bongo
Apr 30 1977 to May 19 1977
Cruise CL01, Old Stepped Oblique Bongo
Aug 08 1977 to Sep 02 1977
Cruise FT01, Old Stepped Oblique Bongo
Sep 21 1977 to Oct 14 1977
Cruise CC02, Old Stepped Oblique Bongo
May 17 1978 to Jul 10 1978

Fig. 8.4.7. Scotian Shelf Ichthyoplankton Program Cruises: Haddock larvae (7+mm).

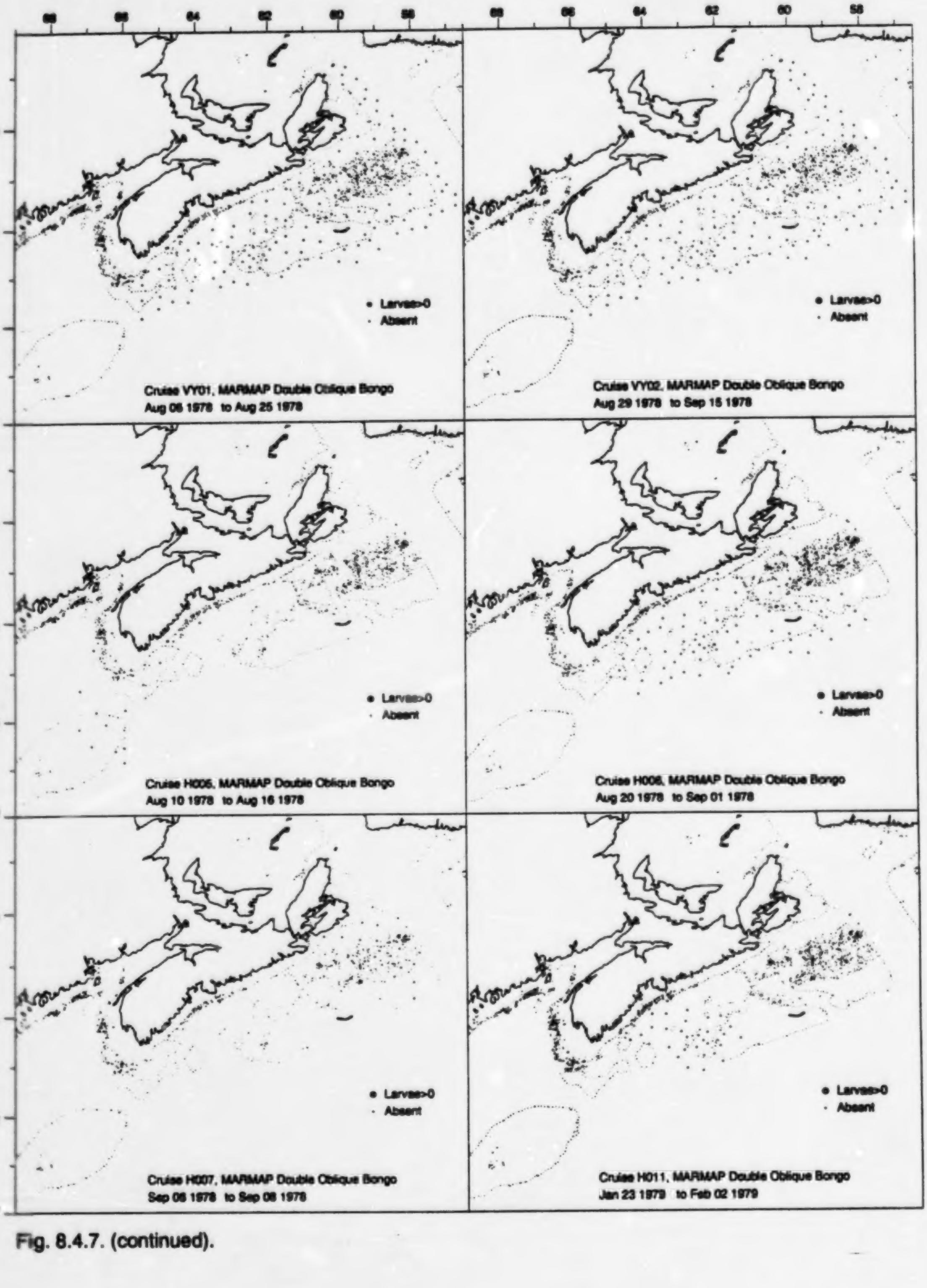
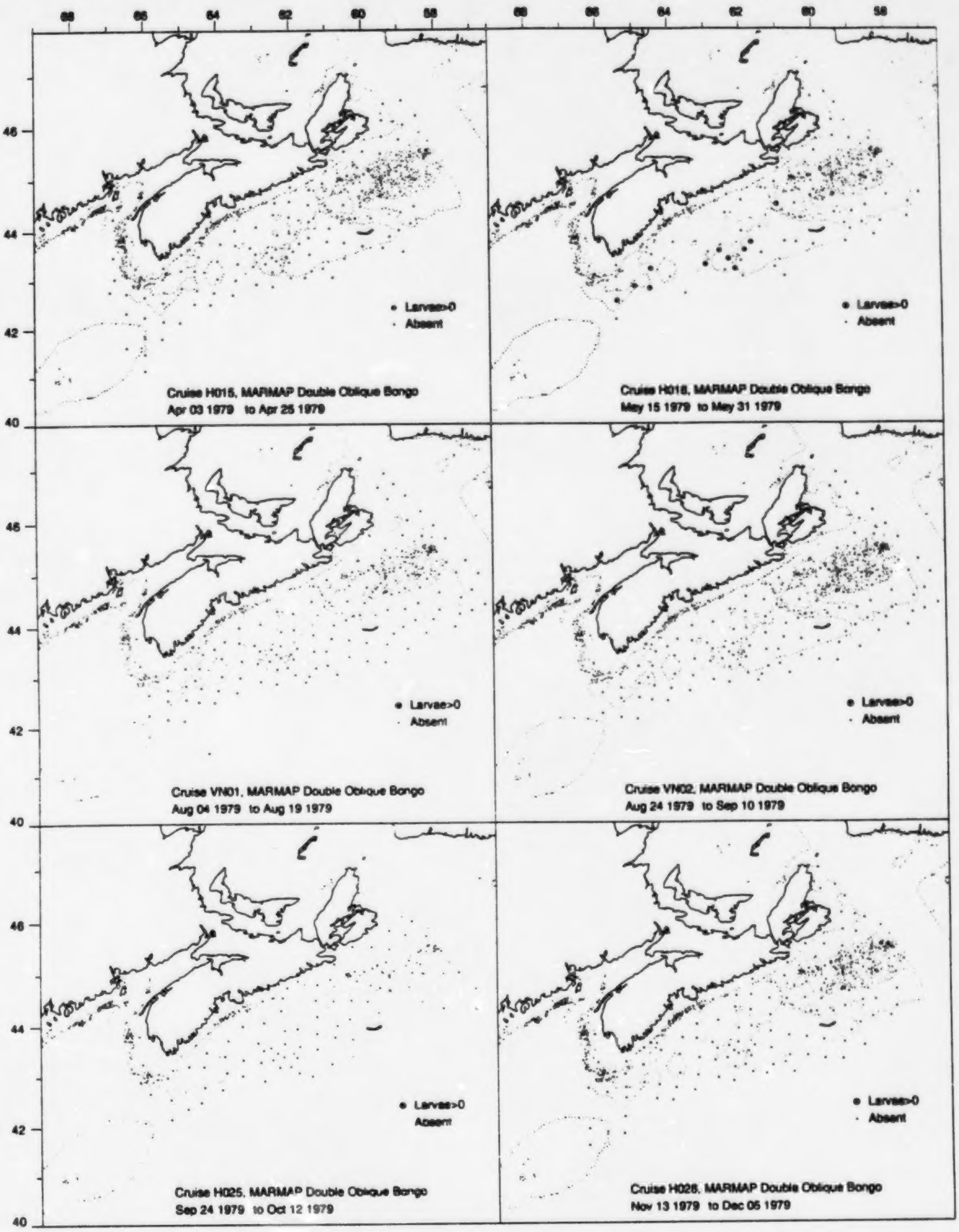

68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent
Cruise VY01, MARMAP Double Oblique Bongo
Aug 06 1978 to Aug 25 1978
Cruise VY02, MARMAP Double Oblique Bongo
Aug 29 1978 to Sep 15 1978
Cruise H005, MARMAP Double Oblique Bongo
Aug 10 1978 to Aug 16 1978
Cruise H006, MARMAP Double Oblique Bongo
Aug 20 1978 to Sep 01 1978
Cruise H007, MARMAP Double Oblique Bongo
Sep 06 1978 to Sep 08 1978
Cruise H011, MARMAP Double Oblique Bongo
Jan 23 1979 to Feb 02 1979

Fig. 8.4.7. (continued).



Cruise H015, MARMAP Double Oblique Bongo
Apr 03 1979 to Apr 25 1979

Cruise H018, MARMAP Double Oblique Bongo
May 15 1979 to May 31 1979

Cruise VN01, MARMAP Double Oblique Bongo
Aug 04 1979 to Aug 19 1979

Cruise VN02, MARMAP Double Oblique Bongo
Aug 24 1979 to Sep 10 1979

Cruise H025, MARMAP Double Oblique Bongo
Sep 24 1979 to Oct 12 1979

Cruise H026, MARMAP Double Oblique Bongo
Nov 13 1979 to Dec 05 1979

Fig. 8.4.7. (continued).

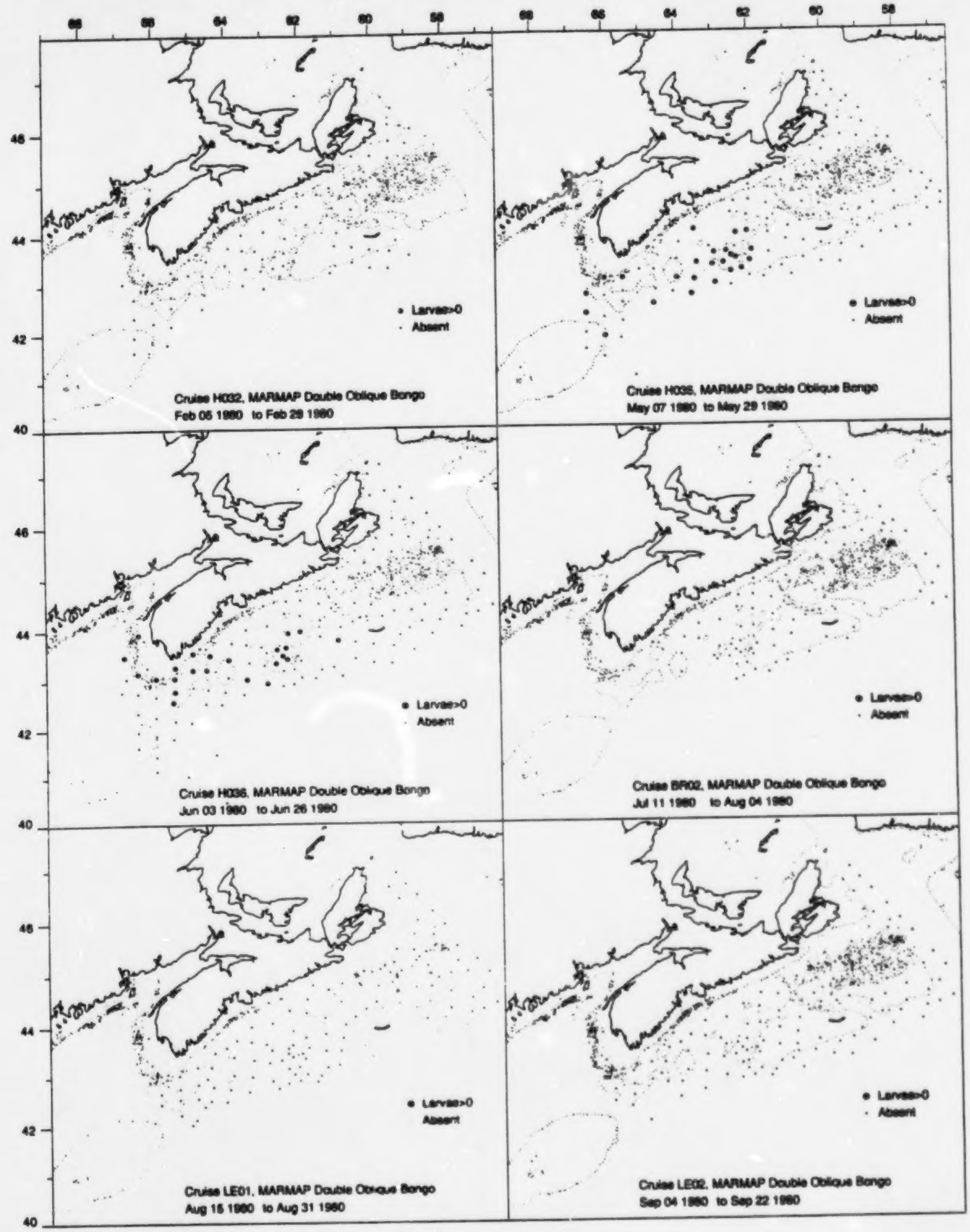

68
66
64
62
60
58
46
44
42
40
● Larvae>0
· Absent
Cruise H032, MARMAP Double Oblique Bongo
Feb 05 1980 to Feb 29 1980
Cruise H035, MARMAP Double Oblique Bongo
May 07 1980 to May 29 1980
Cruise H036, MARMAP Double Oblique Bongo
Jun 03 1980 to Jun 26 1980
Cruise BR02, MARMAP Double Oblique Bongo
Jul 11 1980 to Aug 04 1980
Cruise LE01, MARMAP Double Oblique Bongo
Aug 15 1980 to Aug 31 1980
Cruise LE02, MARMAP Double Oblique Bongo
Sep 04 1980 to Sep 22 1980

Fig. 8.4.7. (continued).

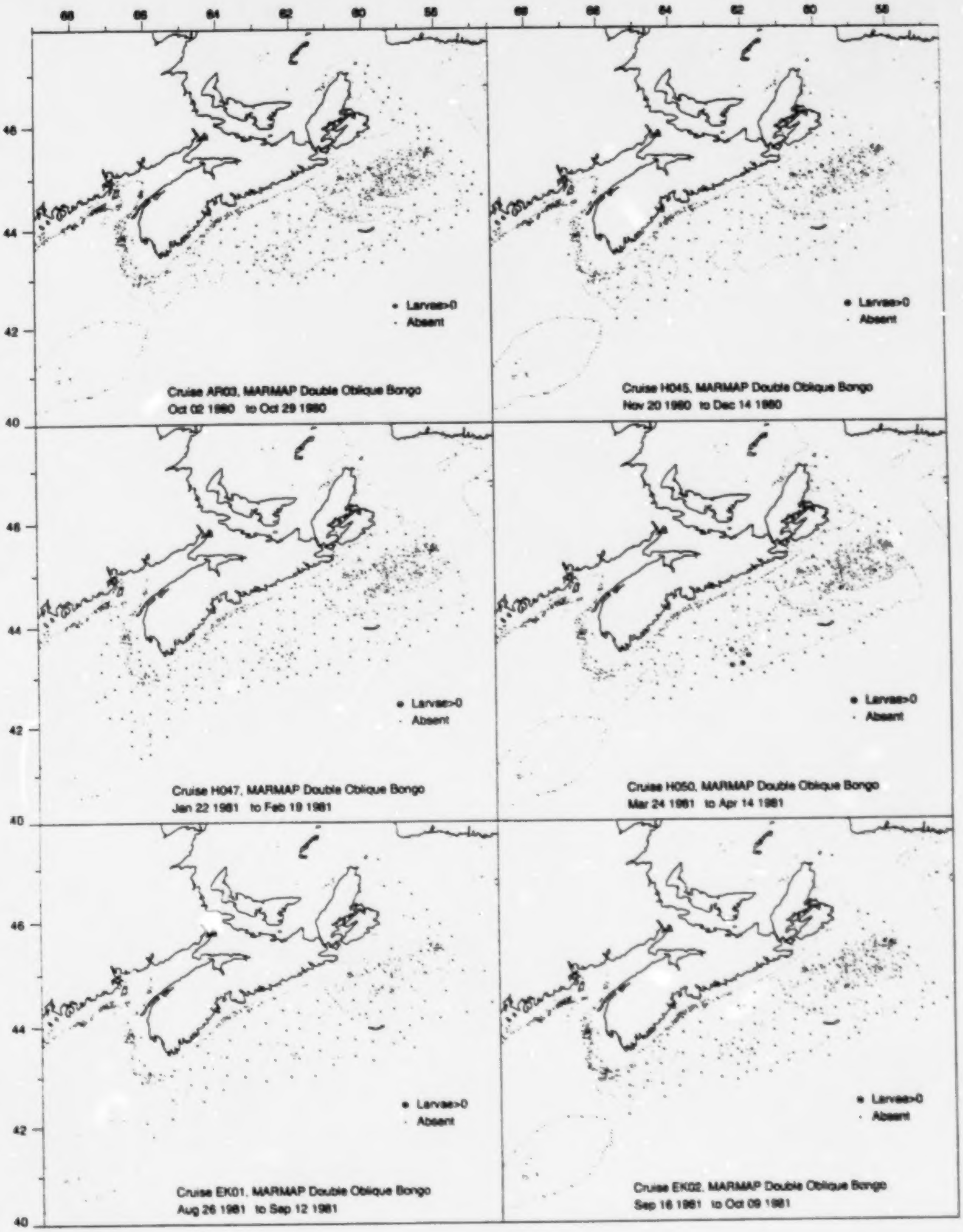

68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent
Cruise AR03, MARMAP Double Oblique Bongo
Oct 02 1980 to Oct 29 1980
Cruise H045, MARMAP Double Oblique Bongo
Nov 20 1980 to Dec 14 1980
Cruise H047, MARMAP Double Oblique Bongo
Jan 22 1981 to Feb 19 1981
Cruise H050, MARMAP Double Oblique Bongo
Mar 24 1981 to Apr 14 1981
Cruise EK01, MARMAP Double Oblique Bongo
Aug 26 1981 to Sep 12 1981
Cruise EK02, MARMAP Double Oblique Bongo
Sep 16 1981 to Oct 09 1981

Fig. 8.4.7. (continued).

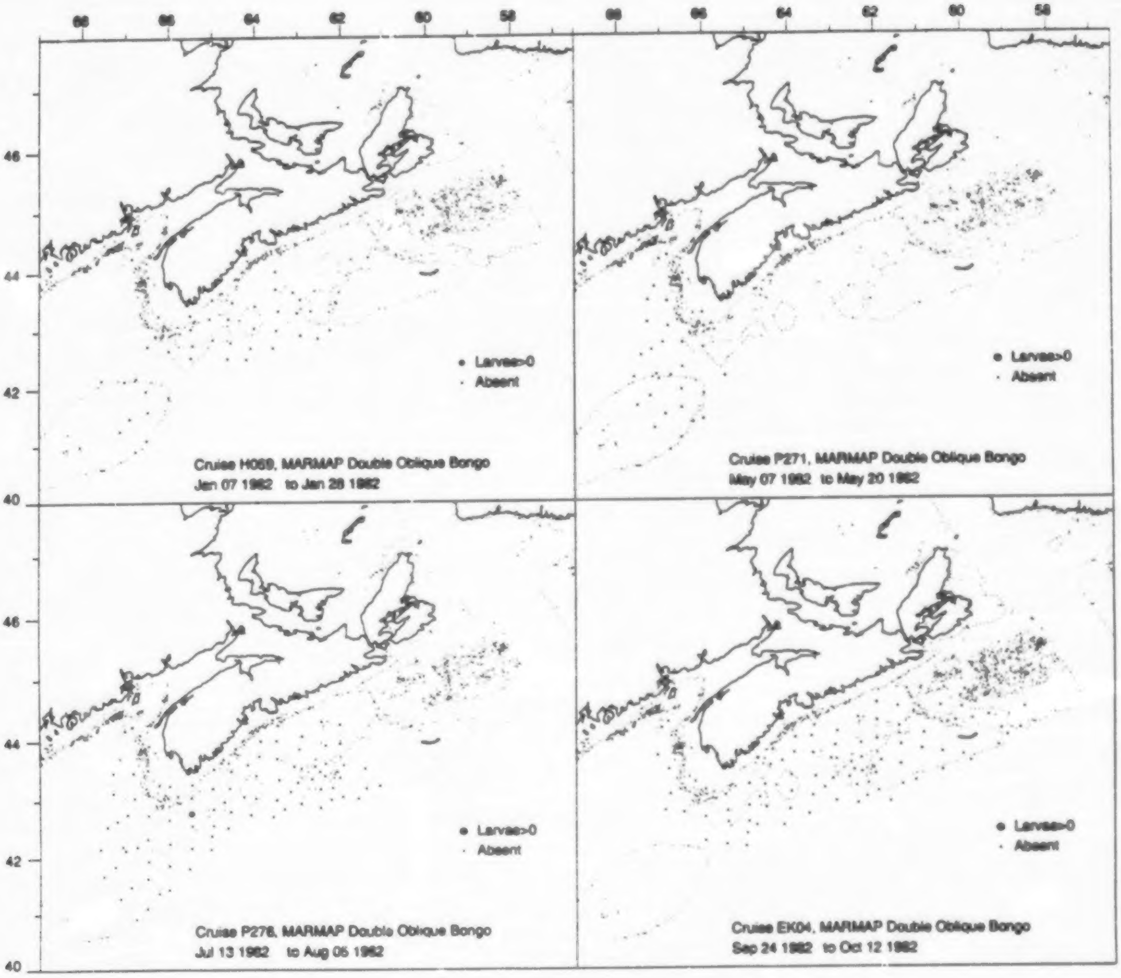

68
66
64
62
60
58
46
44
42
40
Larvae>0
Absent
Cruise H069, MARMAP Double Oblique Bongo
Jan 07 1982 to Jan 28 1982
Cruise P271, MARMAP Double Oblique Bongo
May 07 1982 to May 20 1982
Cruise P278, MARMAP Double Oblique Bongo
Jul 13 1982 to Aug 06 1982
Cruise EK04, MARMAP Double Oblique Bongo
Sep 24 1982 to Oct 12 1982

Fig. 8.4.7. (continued).